SCIENTIFIC AMERICAN

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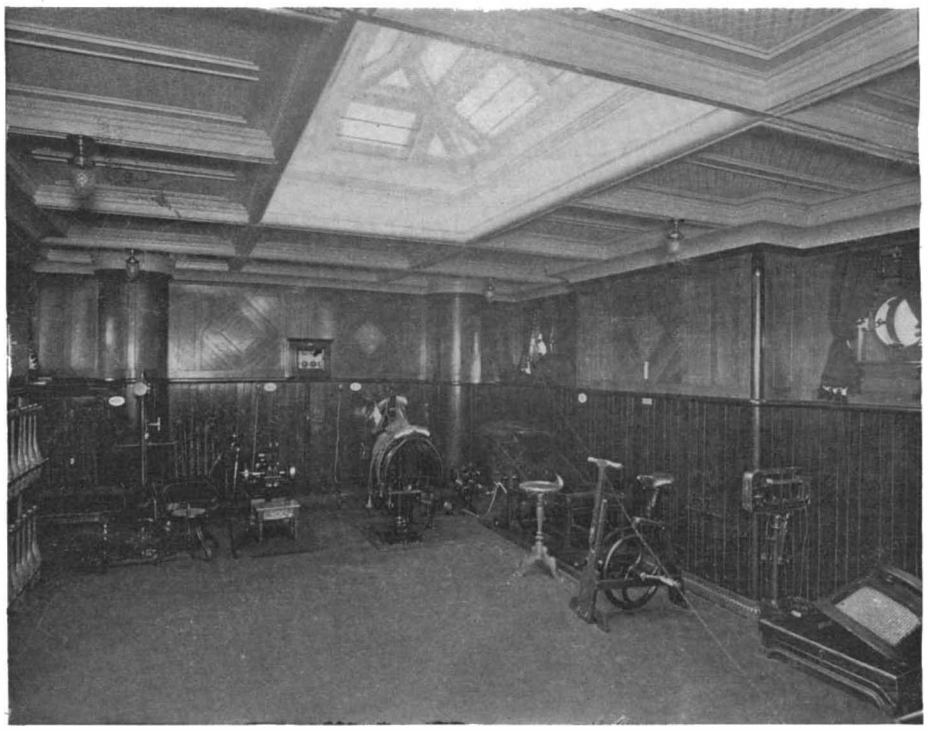
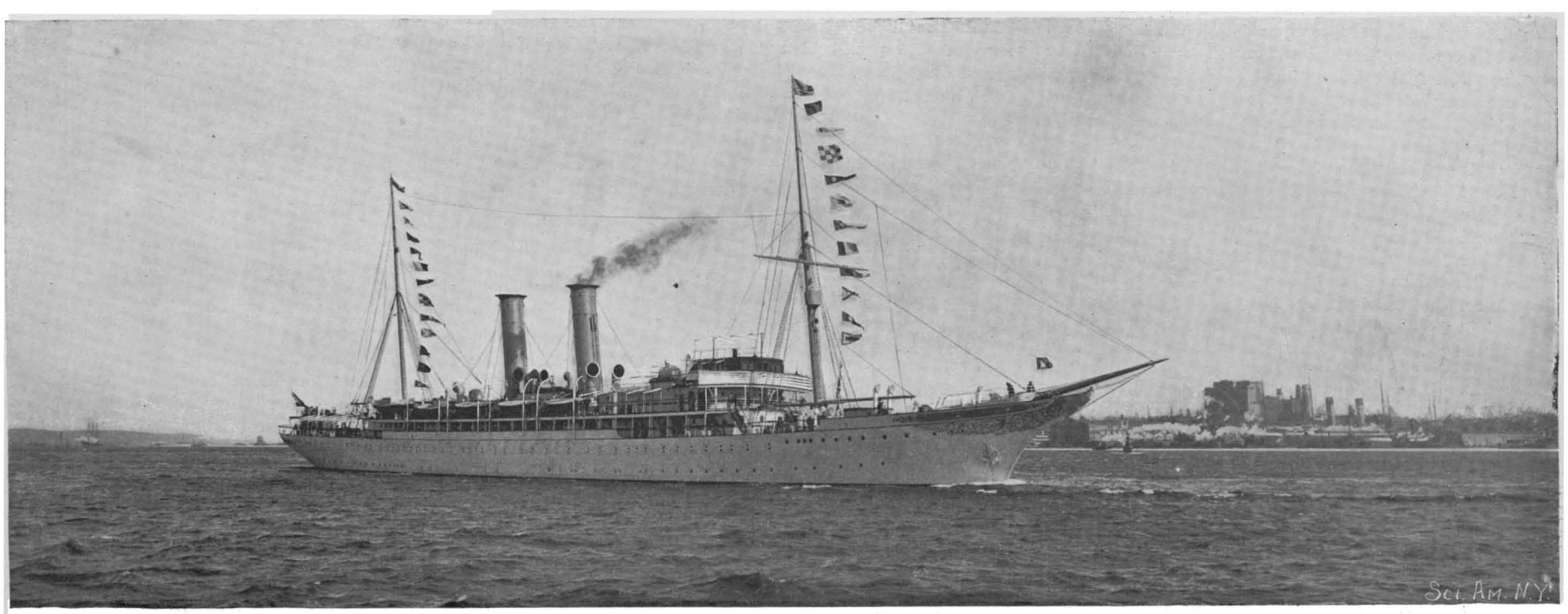
Social Hall.

Smoking-Room.

Gallery, Looking Down into Dining-Saloon.



Gymnasium.



Length, 450 Feet; Beam, 47 Feet; Depth, 30 Feet; Speed, 16 Knots.

HAMBURG-AMERICAN CRUISING YACHT "PRINZESSIN VICTORIA LUISE."--[See page 86.]

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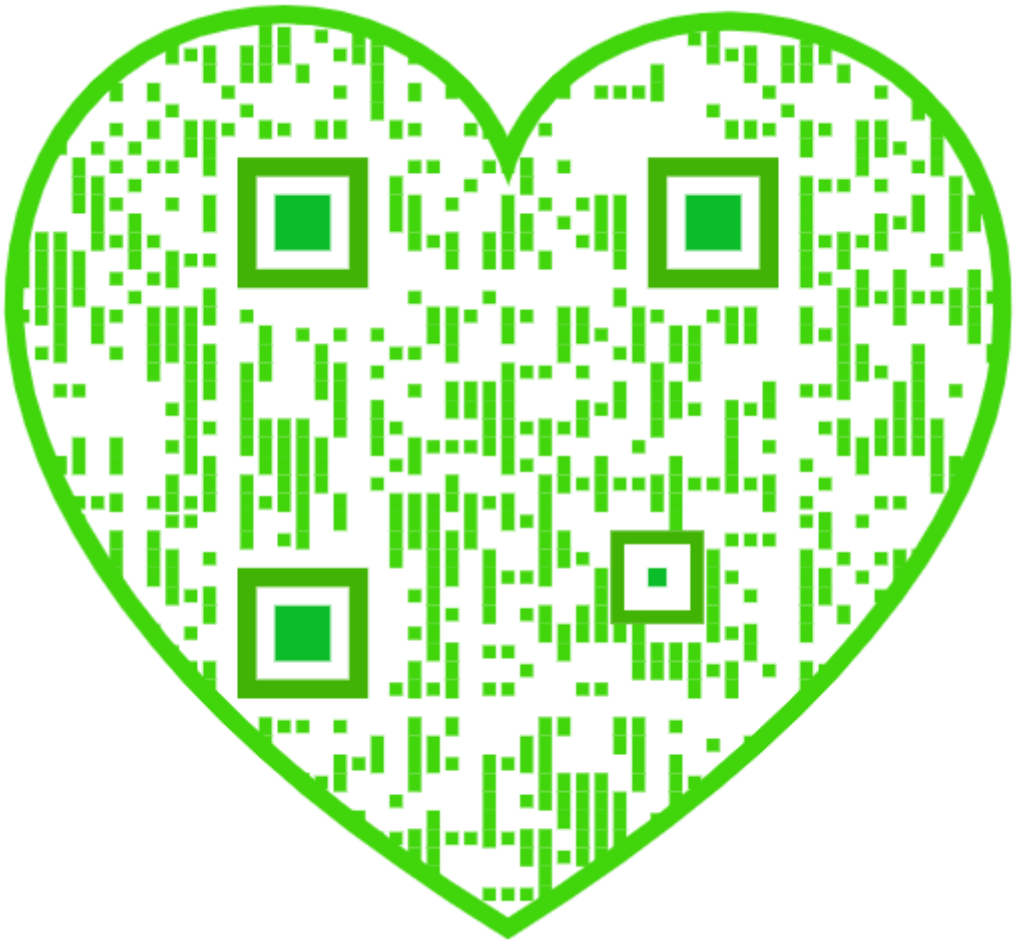

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NEW YORK, SATURDAY, FEBRUARY 9, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RAIL JOINTS AND STREET NOISES

A correspondent from the town of Bridgewater, Nova Scotia, referring to an article in this journal on rail joints and street noises, in which the use of the welded joint was suggested as the best means of getting rid of the loud pounding which seems to be inseparable from the present forms of spliced joints, asks us whether it would not be a better plan to provide a double rail consisting of two lines of rails, laid side by side, so that the joints of one rail would always lie at the middle of the adjoining rail. The idea is not new, and has been tried, we believe, on some European roads, where it was found that although the pounding was reduced, and the low-joint difficulty removed, there were so many attendant disadvantages as more than to neutralize any benefits secured. The separate elements of a double rail must necessarily be bolted together, and the difficulty and labor of keeping the bolts tight is enormous. Our recent suggestion that the elevated railways in this city would do well, in the reconstruction of their road, to introduce the welded joint, has been criticised on the ground that, except where such welded rails are embedded in concrete or Belgian blocks, it is impossible to preserve their alinement, because of the stresses which are set up by expansion and contraction under changes of temperature. We are perfectly aware of the necessity for holding the rails in line during hot weather, but are of the opinion that if screw-bolt connections instead of the inadequate railway spike were used on every tie, and if each tie were bolted to the stringers of the elevated structure, it would be quite possible to hold the rails in alinement even in the hottest summer weather. Such a construction would be costly in maintenance, and might not indeed commend itself to the shareholders; but it would bring relief to the citizens of New York from an inferno of din for which there is no parallel in any city of the world.

POUND-PER-HORSEPOWER ECONOMY.

It seems likely that to the marine engineer will belong the credit of having built and introduced an installation of boilers and engines that is capable of doing day by day work on a fuel consumption of less than a pound of coal, per horse power, per hour. We all remember the world-wide interest which was aroused by the quadruple expansion, five-crank engines of the steamship "Inchmona," which were the first to bring down fuel consumption to the one pound limit. The success of this vessel encouraged the owners of the "Inch" line of steamers, and the Central Machine Engine Works, of West Hartlepool, England, to follow up their experiments, and in the "Inchkeith" and "Inchdune" the consumption has been brought down respectively to 0.99 and 0.97 pound per horse power per hour. We must content ourselves here with giving the salient features of the installation of the vessels, and refer our readers to the next issue of the SUPPLEMENT for the drawings and full particulars. Of these vessels it may be said that every refinement that would bring the performance of their motive power nearer to the theoretically perfect steam engine and boiler has been installed. All the cylinders, with the exception of the high-pressure, are lined and jacketed, the last-named being unjacketed. The cylinders are completely surrounded by steam, all external surfaces being well lagged with asbestos. The expansion is quadruple, in five cylinders, two of which are low-pressure. The boilers are of the Scotch type, and carry a pressure of 267 pounds to the square inch. Above the boiler tubes at the front end is a superheater, and above this are nests of vertical pipes for heating the air on its way to the furnace. Special attention is paid to the feed-water, which is pumped first through a contact heater, then through a surface heater and is filtered before passing to the boilers. The feed-water, which at the hot well has a temperature of 96½ degrees, leaves the contact heater at 209 degrees, and the surface heater at 370 degrees. The steam enters the superheater at 412 degrees and leaves it at 469½ degrees. In the tests the temperature of the air on the deck of the vessel was 53 degrees, and after leaving the heater it entered the furnace at 290 degrees. The temperature of the gases on leaving the boiler tubes was 587 degrees; this was lowered 44 degrees in the superheater, and 41 degrees in the air-heating tubes. The hot gases are drawn through the air-heating tubes and delivered to the smokestack by means of a fan, and such is the saving of heat that their temperature at the fan discharge was lowered to 319 degrees F., that is to say, over 90 degrees below the temperature of the steam in the boilers.

These remarkable results were obtained on a lengthy trial carried out between Hartlepool in the North of England and Dover. If, for the sake of comparison, the consumption be taken as one pound of coal, it is estimated by our contemporary, Engineering, that it is equivalent to a consumption of 15½ tons per day, in a vessel carrying 6,170 tons at 9½ knots an hour, or to 13¼ tons a day at a speed of 9 knots an hour. To put it another way, one ton is carried one knot for a third of an ounce of coal, and with coal at $4 a ton this would be equivalent to carrying one ton of cargo a distance of 275 miles at a cost for fuel of one cent.

PROGRESS OF TURBINE PROPULSION.

An important step in the development of the turbine-propelled vessel has just been taken in the signing of a contract for the construction of a large turbine-propelled passenger steamer for use on the Firth of Clyde. The vessel is to be 250 feet in length, 30 feet in beam, and 11 feet in molded depth, and she is to attain a speed of 20 knots with turbine engines of 3,500 to 4,000 horse power. Power will be developed on three shafts, by a compound turbine; one high-pressure on the center shaft, and two low pressure turbines on the side shafts. The determination to construct a vessel of this size will be welcomed by the builders of deep-sea steamers, for it forms the next logical step in a development which commenced with the little "Turbinia," and was carried on in the 380-ton "Viper" and "Cobra." We understand that probably a contract for a large cross-channel steamer of about 2,000 tons displacement, propelled by turbines, will shortly be let.

AIR RESISTANCE OF RAILWAY TRAINS

Additional light has recently been thrown upon the question of air resistance of railway trains by experiments which were carried out by Prof. Francis E. Nipher, of Washington University, who, upon being called in as an expert in a legal case, in which it was claimed that a boy had been drawn under a fast train by what is popularly known as "air suction," determined to test the action of a moving train upon the air, by actual train experiments. The method adopted was to use a hollow cylinder of brass to collect the air when the train was in motion, the open end being directed toward the front of the train, and the wind pressure being shown by means of a tube connecting the after end of the air collector with a water gage in the car. The air collector was so arranged that it could be placed at a distance from the side of the car varying from nothing to 30 inches. A great number of experiments were made. During one lengthy trial, which was carried out on an express train from St. Louis to Burlington and back, a distance of 316 miles, in which 957 measurements were taken, pressures were recorded of 0.95 pound to 2.62 pounds per square foot, the pressure of 0.95 pound being equivalent to that which would be experienced by a person standing 30 inches from the passing train, and the pressure of 2.62 pounds to the square foot being that which would be experienced by a person standing immediately against a car with just sufficient clearance for it to pass. It was estimated that the pressure, when the collector was thrust far out into the undisturbed air, was 3.42 pounds per square foot. These results, it must be remembered, are true simply for a speed of 40 miles an hour, and at higher speeds of 50, 60 and 70 miles an hour the pressure would increase proportionately.

RELATIVE FIGHTING EFFICIENCY OF WARSHIPS.

We have before us an article by the brilliant Chief Naval Constructor of the German Navy, Otto Kretschmer, in which he offers a method of estimating the relative fighting values of warships. This is not by any means the first time an effort has been made to strike a mean between the various elements of fighting power which go to make up the total fighting value of a ship, and so arrive at a total numerical figure of each vessel, which should enable ships of widely different design to be compared directly and placed in the order of their merit. Such comparisons are necessarily of an arbitrary nature, and the value numbers assigned to the different elements of efficiency will vary in different writers. While the present comparison is extremely ingenious and carefully worked out, the results arrived at are, in the case of the United States vessels, to say the least, very astonishing. No one can accuse the German Chief Naval Constructor of partiality, inasmuch as the battleship "Kaiser Friedrich III." of his own navy is placed eighth on the list of the eleven battleships which enter into the comparison. The highest figure of merit is awarded to the Japanese battleship "Mikasa," which carries 15.23 points. The second most efficient vessel is also a Japanese battleship, the "Shikishima," with 14.15 points; then follow the "Formidable," of Great Britain, 12.47 points; the "Suffren," of France, 11.70; "Duncan," Great Britain," 11.46; "Cesarevitch," Russian, 11.23; "Retvisan," the battleship built by the Cramps for Russia, 9.16; the "Kaiser Friedrich," 7.38; the "Charlemagne," of France, 6.15 points; the "St. Bon," Italy, 5.23; and the "Alabama," of the United States, 5.23. While we are quite willing to admit that the "Mikasa," with 2 knots higher speed, larger coal capacity, and bigger displacement, is a better ship than the "Alabama," it is, on the face of it, absurd to affirm that the ratio for fighting values is as 15 to 5. It seems that the data used by the author was taken from an Austrian naval annual, and it is likely that the gun power of the "Alabama" is based upon the supposed use of the old brown powder. Moreover, it is also possible that the normal has been confused with the maximum coal capacity. A few errors of this kind will readily account for the low position of this vessel on the list. On the whole, we think that the comparative table before us simply affords additional proof of the impossibility of determining, except by the actual test of battle, just what is the relative efficiency of warships of widely different design.

COMPARATIVE COST OF PRIME MOVERS.

The present century will not have run very far on its course before the manufacturers of industrial establishments will be confronted with the problem of making a choice between three or four different prime movers, with a view to selecting the one which has the strongest recommendation on the grounds of economy. This choice will not be an easy one, except in certain specified localities where the conditions are such as to make the adoption of a particular type of power clearly desirable. In the nineteenth century no choice of powers has presented itself, not at any rate in the second and third quarters of the century, in which the steam engine had established itself as the universal prime mover without any serious competitor in sight. In the last quarter of the century, it is true, the wonderful development of the water turbine, the electric generator, and the transmission line, has brought into the field a competitor whose superior economy is undisputed when the competition takes place in the immediate locality in which the water power is developed. This superiority, indeed, is only challenged when the increasing length of the line begins to multiply the cost of the transmission.

The most notable developments of hydraulic power which have taken place in the past decade are those at Haute-Saboie in France, at Rheinfelden in Germany, and at Niagara; and the undoubted success of these installations has led to the construction of a large number of less important plants, that differ from these merely in the magnitude of power developed, and the details of the turbines and generators. It is probable that at the present writing the total amount of hydraulic electric power which is now being generated the world over is somewhere between 400,000 and 500,000 horse power. There are signs, in the opening years of the century, that a third competitor in the generation of large quantities of power in central stations has appeared in the shape of the utilization of furnace and producer gas in gas engines of large dimensions. Gas engines of as high as 700 horse power have been built, and they are working smoothly and economically, while at several mills in Belgium the blast furnace gases have been used for driving gas engines which supply the blast.

The question of the relative economy of steam, water and gas was treated at considerable length in a paper presented by Mr. J. B. C. Kershaw at a recent meeting of the British Association, and the conclusions which were reached were based upon a large amount of data, which had been carefully gathered from various existing plants. In order to secure a common basis of comparison the author has calculated the results upon the basis of the cost per year of 8,760 hours, the results being tabulated in connection with the locality in which they were achieved, with the object that local conditions, such as cost of labor, fuel, transportation, etc., might carry their full weight.

In regard to hydraulic power there is considerable variation in the cost, due chiefly to the wide difference in the first cost of the plant. But little preliminary work was required in some cases, while in others there was a vast amount of costly work in the construc-

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tion of canals, forebays, tailraces, and other concomitants of a hydraulic-electric installation. The first cost per horse power varies from $17, at Vallorbes, to $320, at Lyons, France. The charge to consumers is determined very largely by the cost of the distribution. Thus, in Norway, the price per electric horse power, per year of 8,760 hours, is $5, while at Niagara the average price is $21, the charge depending considerably upon the amount that is required by the consumer.

From the estimates of the lowest practicable cost of steam power we gather that in America the lowest practicable cost for steam per horse power per year is under the most favorable conditions $17.50, and in the United Kingdom $18. In Switzerland the lowest cost of steam power is placed at $45 per year. Under normal conditions, for steam power to compete successfully with water power, the former must be generated in bulk. If this be done, it is estimated that a 50,000-horsepower plant using coal at $1.75 per ton could produce power at a cost of $18 per horse power per year.

With reference to gas power, the author is of the opinion that the cost depends greatly upon the source and character of the gas, while to realize higher economy for gas engines over steam engines, it is not necessary to use the largest sizes, the economy being particularly marked in motors of moderate size. It is estimated by Meyer that if blast furnace gas be used the cost of an electric horse power per year will be $20, and that with the use of Mond producer gas the cost will be $25 per year.

Summing up, a comparative estimate based upon the lowest actually recorded cost for water power and steam power shows that hydraulic power in Canada is being produced at a cost of $6.25 per annum, that in England the lowest actual cost of steam per horse power is $20 per annum, while in Germany, with gas engines using furnace gas, the lowest estimated cost per horse power per year is $20, and in England, with the use of producer gas, the lowest estimated cost per annum per horse power is $25. While this comparison verifies the general opinion that if the first cost is not excessive, the water turbine is by far the cheapest of all prime movers, when the first cost of the hydraulic plant is heavy, or the transmission line exceeds a certain length, the difference between the relative cost of water, steam, and gas power gradually disappears.

EFFICIENCY IN ACTION.

Is it not to be inferred from remarks in the December 1* issue of the SCIENTIFIC AMERICAN on "The Comparative Efficiency of the Krupp, Armstrong and Schneider-Canet Guns" that the naval ordnance expert secures efficiency of fire rather more through the medium of high projectile velocities than that of projectile weights? There appears, however, to be an exception to this rule, in the case further on recited, as relates to the German navy. It is well known that projectiles disproportionately reduced in the matter of weight for the caliber are so conditioned as to have imparted to them extremely high muzzle velocities without at the time exceeding the prescribed pressure limits, and the error of this practice cannot be better appreciated than in the case of cork or wood projected from a rifle and made to penetrate resisting media, like that of wood, plank or glass, and without change of form, when the penetration follows the instant of passage of such projectile from the bore of the gun.

If we consider this matter of projectile weights and velocities from the small arm standpoint, it will be found that there is a special ratio of weight to the area of cross-section for small arm projectiles, which serves as a guide in the ballistic problem, this ratio being 3,000 grains per inch area of cross-section.

It would therefore be unwise, before a ratio has been settled upon in the construction of any projectile, to determine beforehand upon any arbitrary velocity. It would be better in the first place to properly proportion the projectile and after that ascertain by experiment the velocity which shall accord or accommodate itself to the powder pressure restrictions. Proceeding upon any other line is absolutely incorrect and is of the nature of ignorance or pretense. Keeping in mind this idea our argument may be carried to a legitimate conclusion.

The writer of the article before referred to states that the velocities employed in the naval service are much higher than those common to weapons for field guns, and that "regret is expressed by many naval officers to see the 13-inch gun displaced by the 12-inch, the hitting power of the 13-inch shell at long range being considerably greater than that of the older 12-inch shell." Are we to infer from this that the weight of the 12-inch projectile has been reduced in a ratio to its area of cross-section not in accord with ballistic requirements and the purpose of increasing its muzzle velocity to secure a muzzle energy approaching that of the 13-inch rifle, but which ratio of construction results in disproportionate loss of energy at battle ranges?

The relative weights of properly proportioned projectiles for the 13-inch and 12-inch calibers with like "sectional density" requires their ratio to hold at figures of 17 to 14, that is inversely as the square of the diameter of their cross-sections, and not as the cube of this homologous line where a similar proportioned projectile is sought for.

"When the public hears that a gun of a certain caliber is capable of a velocity of 3,000 feet per second, as against velocities of 2,600 feet per second in other guns of the same caliber," it is usually inferred that "the high velocity weapon is incontestably the most effective," whereas should consideration not have been given to the weight of projectile employed, the statement is quite misleading.

What, we ask, is the purpose of the naval ordnance expert in so constructing projectiles as to be ill-proportioned to ballistic requirements? Are his estimates based entirely upon work at close quarters or short ranges, where muzzle energy is the criterion of efficiency; or is the sacrifice due to an effort to provide the greatest total number of rounds that the restrictions of vessels' ton displacement will permit? What is the value of muzzle energy and penetration, if followed by anything assimilating the instability in flight of cork or wood projectiles or where the impact energy at ranges where real work is expected to be accomplished is disproportionately and materially reduced?

"In determining upon the armament of their navy, the Germans have evidently been governed by this consideration (the hitting power of the projectile), for it is a fact that Krupp guns, with which their ships are armed, fire projectiles which are considerably heavier for any given size of gun than those used in any other navy.

"Although the muzzle velocities given in the ballistic tables of these guns are not so high as those of other nations, the muzzle energies are greater, and the '*remaining energies*' are *enormously* so." (The *italics* are ours.)

Here the German at least appears to be working on proper lines, and whatever reason there may be to justify a variety of velocities and projectile weights for the like caliber guns, it is not at all clear that because the 13-inch rifle in our service is disparaged by a comparison of its muzzle energy with that of its rival the 12-inch, our land defense should be expected to discount stable platforms and favorable conditions as to weights and their accessories incident to and necessary for the service of monster rifles. Certain it is this land defense must not be and never will be subordinated to the restrictions imposed upon batteries afloat, nor can it afford to avail itself of all advantages of the kind noted.

The one and half per cent of hits, of all shots fired at Santiago by our fleet in the running fight with the enemy, showed more favorably for the smaller and so-called "rapid-fire guns" than for those of larger caliber; but this engagement is insignificant in comparison with conflicts yet to be anticipated upon the sea. There has been nothing either here or at Manila to suggest the dismounting of the heaviest type of guns on our seaboard, or the removal of disappearing carriages where already they have been placed.

Reverting again to the small arm or miniature phase of the problem, here at least is a sphere of action where the fighting factors on land and sea are bound by common ties and should be governed by common principles. A caliber, 0.23, was at first selected for the navy rifle, and a 135-grain bullet was at first adopted and then discarded in favor of the 112-grain miniature *capsule*.

In this instance had the same prejudice for light weights and high velocities permeated the entire system? How much better it would have been to follow the ratio (3,000 grains per inch area of cross-section) employed in the 0.45 caliber Hotchkiss navy rifle in the army 0.45 caliber Springfield small arm, and one which had been accepted for the army 0.30 caliber magazine arm.

What follows from the 2,700 feet per second muzzle velocity of this 112-grain bullet? A falling off from the extravagant start to 971 feet at one-half mile range, while, on the other hand, a well-proportioned bullet of 135 grains weight for the caliber, with its start of 2,500 feet per second, makes a showing by some 40 feet per second in excess of this "remaining velocity" at this half-mile range.

In other words, the disproportioned bullet has lost 1,729 feet or 66 per cent of its original velocity, while the well-proportioned bullet loses but 1,490 feet or 60 per cent of its original velocity, and both arrive with energies in the ratio of 234 to 305 foot-pounds respectively in favor of the bullet of proper weight. What has the high velocity advocate to say, after this?

Further than this, the lesser weight of bullet at the greater mile range by computation indicates but 90 foot-pounds "remaining energy," against 130 foot-pounds for the greater weight projectile of the same caliber, and this notwithstanding the fact that the muzzle velocity of the more weighty bullet was but 93 per cent of that of its lighter competitor.

In the foregoing comparison of ballistic properties the writer has erred on the right side of the argument by assuming values for velocities in the computations so great as 2,700 and 2,500 feet per second, whereas such velocities cannot be and never have been realized in practice. Computation somewhat nearer the mark will be found in estimates of 2,500 and 2,300 foot-seconds respectively, and such ratio will be useful and comparable with that of the 0.30 caliber rifle projectile, which is the present adopted caliber for both services. The muzzle velocity for the 0.30 caliber arm does not exceed 2,000 feet per second, but its weight of bullet (220 grains) more than compensates for this.

The efficiency of this 0.30 caliber weight of projectile with but 2,000 feet per second muzzle velocity is quite marked at the half-mile range, and even allowing a start of 2,700 feet per second for its little (112-grain) competitor the ratio of velocities for these bullets for this range is as 901 to 971 respectively, and their "remaining energies" for the range as 234 to 397 in favor of the 0.30 caliber bullet, a ratio falling off to 175 and 90 foot-pounds respectively at a range of one mile. If anything were wanting to stimulate the practical man in his effort to secure the greatest efficiency with arms of all calibers it would be to look a little closely into this matter of weights. X.

*See also SUPPLEMENT December 1.

SCIENCE NOTES.

A fire in the pathological museum of the University of Berlin on January 16 damaged Prof. Virchow's collection of skeletons and other objects.

The new mint at Philadelphia, Pa., is being sumptuously decorated with glass mosaic. The mosaics with figures are eleven in number, and have been designed by Mr. William B. Van Ingen.

The patrol wagons of Allegheny, Pa., have been equipped with medical outfits, and the sergeants of the police have been instructed how to render aid to the sufferings of victims of accidents. The equipment includes antidotes for poisoning, dressings for burns and almost everything that is used in emergency cases.

A large pottery firm in Staffordshire (England) has been carrying out a series of experiments with a view to manufacturing glazed china without white lead. The mortality among the workers, due to white lead poisoning, is heavy, and efforts have been made for some time past by legislative and other methods to reduce the misery of the employes engaged in this trade. The firm in question has produced numerous articles by an improved process, which are equal in every respect to those produced by the white lead process. Attempts are also to be made to apply the system to the manufacture of earthenware.

The Comte da Schio is busily engaged in the construction of his airship. The first vessel will be a small one, measuring only about 100 feet in length. It will have accommodation for two passengers. The power for propelling the vessel will be placed in the fore part of the car. Should the preliminary trials prove successful the Comte proposes to construct a larger machine. The Duke of the Abruzzi is displaying a keen interest in the invention, and has expressed a desire to accompany the inventor upon his maiden voyage. Should the machine prove successful it is quite possible that the Duke of the Abruzzi may take it with him upon his next Arctic expedition. The Comte does not claim to be able to sail against the wind. His intention is rather to take further advantage of the winds blowing in the direction in which he is traveling, to aid him in the steering of his machine.

The strike among the lace workers of Calais will have the effect of considerably injuring this important French industry. No less than 14,000 employés are standing idle. For some years past the competition between the Calais and Nottingham lace manufacturers has been very acute, and now that cessation of work has ensued at the French center, the lace makers of Nottingham will reap inestimable benefit. The specialty of the Calais trade industry, however, is the manufacture of the silk lace for mantle makers, but, owing to the demand for the article being very limited, it is not anticipated that the Nottingham makers will compete very energetically in this field. It is in the manufacture of the Valenciennes, fancy cotton laces, and cotton fancy nets that the French trade will suffer. The French article has never been equal in quality or finish to the English product, and consequently it has been somewhat cheaper, but once the trade returns to Nottingham it is doubtful whether Calais will ever regain it, owing to the tendency among the English manufacturers to lower their prices.

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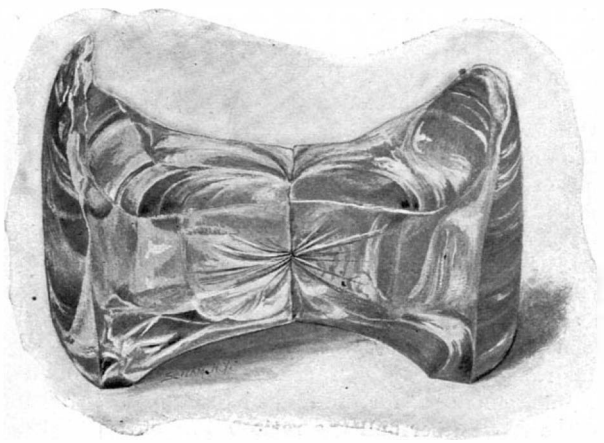
THE SPONTANEOUS BREAKING OF AN INKWELL.

If a mass of molten metal or of glass be allowed to cool suddenly, the outer portions will be chilled while the inner portions are still hot, and the thinner portions will be cooled more quickly than the thicker portions. The arrangement of molecules which results from this unequal cooling leaves parts of the mass under a tension so great that a very slight shock



SPONTANEOUS FRACTURE OF AN IMPERFECTLY ANNEALED INKWELL.

or even a change of temperature may cause fractures. That is why lamp-chimneys often break so mysteriously, and that is why the inkwell of which Mr. George L. Minnott, the postmaster of Worcester, Mass., sent us the picture herewith reproduced, cracked so curiously when ink was poured into it.

Glass vessels not properly annealed may be kept for years before they break; for it is only under certain conditions that such accidents occur. Every boy has seen those curious "Prince Rupert's drops"—made of molten glass which has been dropped into water and thus suddenly chilled—the heads of which are so hard that they resist sharp blows, but the long tails of which, when broken, suddenly destroy the unequal strains and reduce the drops to mere dust. Another singular instance of unequal strain is to be found in the Bologna flask, the body of which is capable of withstanding severe blows, but the thick bottom of which is under so great a tension that it is shattered by a slight scratch.

The post office inkwell is merely a modified Prince Rupert drop or Bologna flask, imperfectly annealed and easily broken by a sudden change of temperature or by a blow properly delivered.

THE SUBWAY OF THE CITY OF BERLIN.

The building of the elevated railway of the city of Berlin has so far progressed that the major portion of the structure is now almost completed. The subway system which, together with this elevated railway, will relieve the congestion of Berlin's traffic, is also in the course of construction, and is now, according to the Illustrirte Zeitung, in its most interesting stage.

From the main road of the system, extending from east to west (from the Warsaw Bridge to the Zoological Gardens), a branch line, about 1,200 yards in length, runs to the Potsdamer Platz and ends there in an underground terminal. From the junction of this branch line with the main line, the road descends 4.2 meters (13.7 feet) below the surface of the Potsdamer Platz, passing first over a bridge which spans the Landwehrkanal and then running down a ramp between Köthenerstrasse and the Potsdamer Ringbahnhof toward the Droschkenplatz (cab-stand) of the Potsdam Station. The down grade or ramp carries the road beneath the street level, from the Droschkenplatz to the Potsdamer Platz, a distance of about 300 meters (984 feet). This part of the road under the Droschkenplatz is so far advanced that the form which the subway will assume can easily be seen. Here the subway is to be made wide enough to accommodate four tracks. Excavations to a depth of 3.5 meters (11.5 feet) were first made. Then, in the line of the walls of the tunnel, trenches were dug down to the lowest level of the tunnel excavation. In these trenches a watertight asphalt-felt sheathing and concrete side walls were built.

Before the roof is placed upon these side walls, the earth and rock still remaining is excavated and carried away by open box-cars either to those places where it can be utilized or to the Landwehrkanal, where it is loaded on scows. When the excavation for the tunnel has been carried to the full depth, concrete is laid to receive a water-tight sheathing, consisting of three layers of asphalt, which are connected with the asphalt-felt of the side wall sheathing. The tunnel is therefore embedded as it were in a continuous water-tight trough. The floor of the tunnel consists of concrete three and one-quarter feet thick. The roof is formed by extending steel beams, spaced 5 feet apart, from wall to wall of the tunnel and filling in the spaces with arched concrete, which is finished off flush with the tops of the beams. Over the entire surface, thus formed, a water-tight sheathing of asphalt-felt is laid. By reason of the exceptional width of this portion of the tunnel, iron pillars will be set up between the tracks, except at those places where switches may be necessary.

The second stretch of this underground road will be constructed in a similar manner. As our first illustration shows, the tunnel is built so that the street traffic is interfered with as little as possible.

In order to drain off the water which is here and there encountered, pipes are laid at each side of the tunnel (as shown in Fig. 2) through which the water is pumped by centrifugal pumps to a main leading to the Landwehrkanal. After the water has been thus removed, excavation can be resumed. To prevent caving in, the sides of the excavation are shored up with boards and cross braces, the shoring being removed as the construction of the side walls progresses.

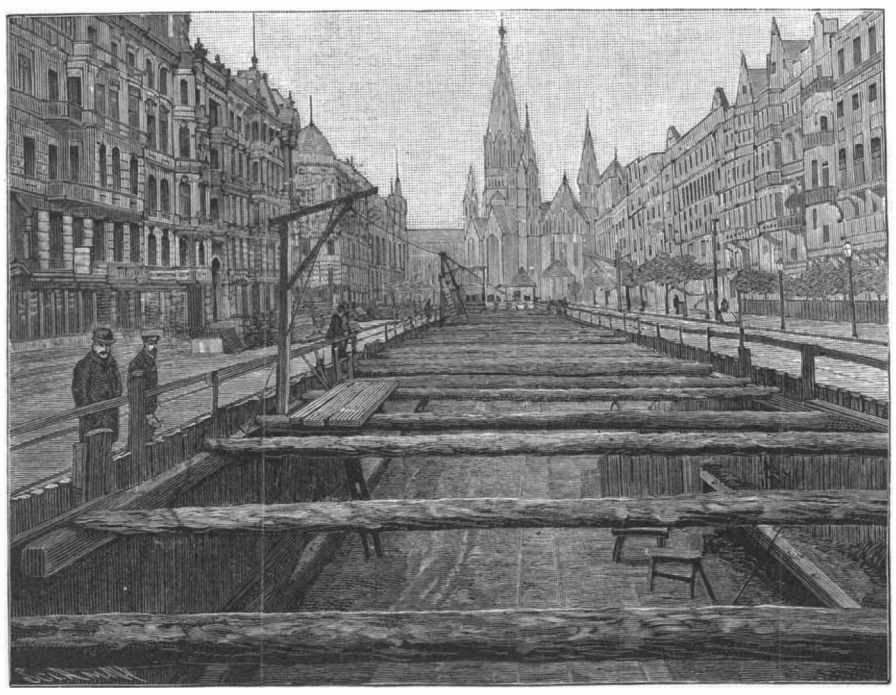


Fig. 1.—THE BERLIN SUBWAY IN TAUENZIENSTRASSE.

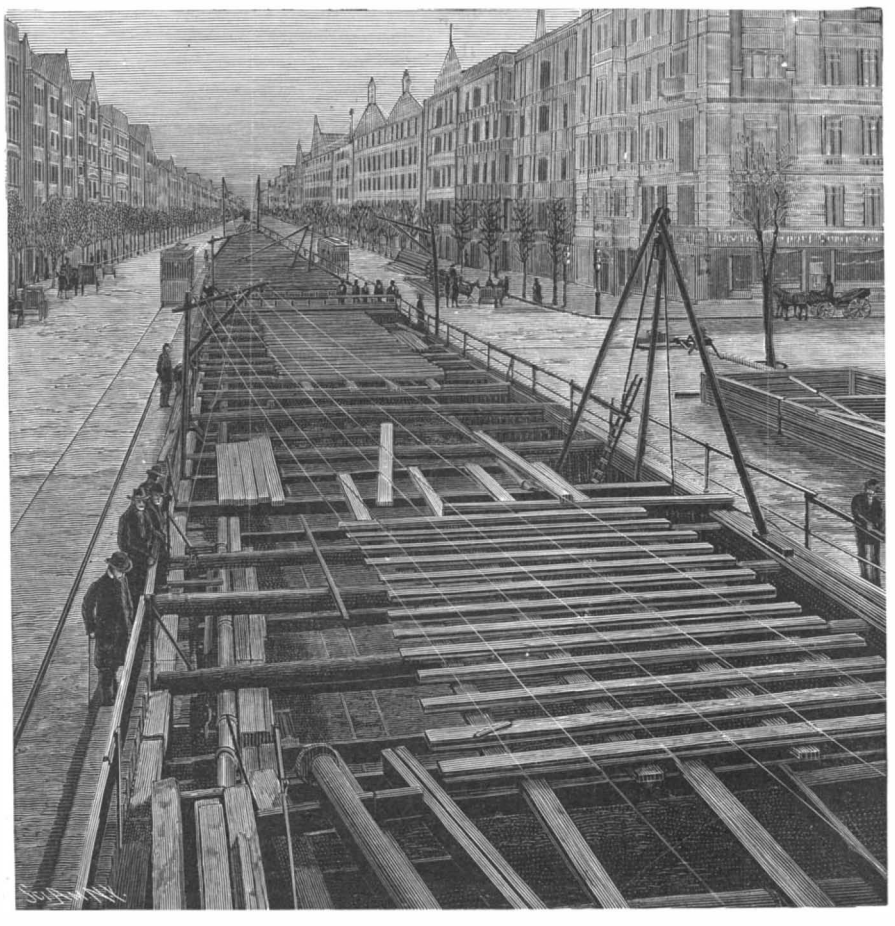
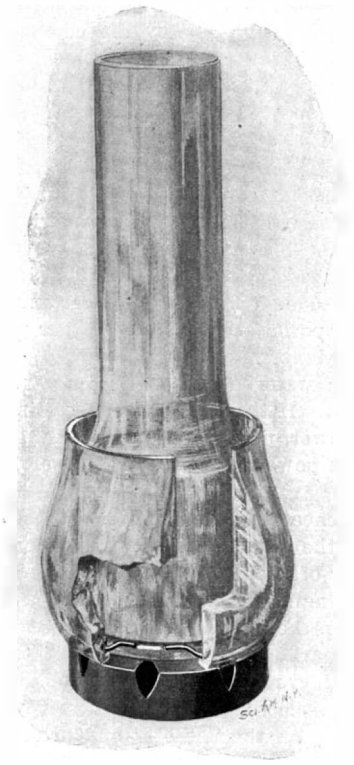


Fig. 2.—EXCAVATIONS FOR BERLIN SUBWAY, SHOWING THE WATER PIPES.

A LENS ATTACHMENT FOR LAMPS.

In order to increase the illuminating power of lamps a Cincinnati inventor, John C. Molloy, places a tubular



TUBULAR LENS FOR LAMPS.

lens around the lamp-chimney opposite the flame and holds the lens concentrically with the chimney by means of a retaining and spacing ring, so that an air-space is left. By this arrangement the lens is securely held in place on the lamp and so refracts the light that the illumination of a room is effectually increased.

The Trans-Siberian Railway.

The Trans-Siberian Railway authorities have had a great deal of trouble with Lake Baikal. The lake is about 65 miles wide, very deep, and exceedingly stormy the greater part of the year. The banks are very marshy for a long distance from the water line to the hard surface. At present they have large ice breaking steamers of the American system, with barges attached for transportation of passengers and merchandise. The cars are also conveyed on these barges. This preliminary arrangement was made, as they were in a hurry to make connections, while at the same time they were surveying a line around the lake. It sometimes happens that passengers and cars cannot be landed on the other side, in consequence of the storms on the lake, and are kept on board of the steamers from twenty-five to forty hours at a time.

At present they have finished the surveying of two Kroogo-Baikal lines. The word "kroogo" means "circuit." One of these lines has been selected and will no doubt be built in the near future. This will run by way of Olchy and Toogoontchili, thus avoiding a number of tunnels, so that in the whole distance from Irkutsk to Kooltooga it will only be necessary to build two tunnels, each 1,120 feet long. By this means several million rubles will be saved which were expected to be expended in the construction of the line around the lake. Engineers believe that if the selected line is again carefully looked over even the two tunnels can be avoided, and in this case there will be no underground excavations to be made on this section.

Wireless telegraphy in Honolulu and the various islands of the Hawaiian group is now in practical working order. The stations on the various islands have all been established, and the tests made show that everything is in perfect order. Commercial messages will now be received. The service will include all of the islands except Kauai. One station is at Honolulu, one at Hilo and one on the island of Lanai; the latter is the connecting station between the two others. By means of a cable messages can be sent from Lanai to the island of Maui.

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THE TELEPHONE AUTO-COMMUTATOR.

Every one who is obliged to use a telephone knows how long it takes to make connections in the central office. Inventors have dreamed of devising some means whereby it would be possible to permit subscribers to call one another without the aid of the central office.

Such a scheme seems visionary at first sight, since a person naturally asks how it could be possible for an apparatus, at any instant, to select, out of ten thousand subscribers, any two who wish to be momentarily connected.

It is a fact that during the twenty years that telephone lines have been operated it has been impossible to accomplish this object, although several apparatus have been proposed and tried. The Direction Générale des Postes et des Télégraphes, which has conducted the French telephone system since 1891, installed in its offices about three months ago, says La Nature, a trial apparatus invented by an American and called an "Auto-Commutator," which appears to combine all the features requisite for attaining the end desired.

The auto-commutator gives direct communication at once, without any confusion in the line, and assures entire secrecy of the conversation. If the station called up is "busy" the subscriber calling is at once notified of the fact by a peculiar humming sound produced by his instrument.

We will not undertake to give a complete description of the mechanism by which these different results are obtained, but will endeavor merely to explain the principle of the system. All the subscribers are connected with a central station (Fig. 3), where each is represented by a commutator apparatus (Fig. 1) at which terminate the line wires of all the other subscribers.

Each subscriber has an instrument (Fig. 2) which comprises a battery, the usual devices for conversation (transmitter, *P*, and receiver, *E*), a call bell, and a special mechanism which is indicated at the exterior by a dial, *L*, provided with figures of the decimal numeration. This dial is movable around a central pivot, and is provided at its circumference, opposite each figure, with an aperture into which the finger may be inserted. In order to form any number whatever, each of the figures that goes to make up the number is brought in succession opposite a stop fixed beneath the dial. After each figure is thus indicated the finger is removed from the aperture corresponding to such figure, and the dial returns automatically to its initial position. The dial in its motions carries along with it a toothed wheel which is connected with the battery and breaks the circuit of a number equal to the figure indicated by every movement. For example, when the finger is inserted in aperture 5, and the latter is moved to the stop, five emissions of current are produced in the line. The commutator placed in the central office is actuated by this current. An electro-magnet, *E*, at each emission causes a vertical rod, *A B C*, to ascend one notch. This rod carries three horizontal pins, which can be brought in contact with the extremities of all the wires. The wires are arranged circularly, one alongside of the other, in superposed rows, at the bottom, *D*, of the apparatus.

It is therefore possible, from the calling station, to determine the vertical position of the pins 1, 2, 3 opposite the row which has been chosen. And by the rotation of the rod, *A B C*, the horizontal position of the same pins, which must be assumed in order to make the necessary contacts, can be likewise determined. In order to obtain greater resources in the combinations the two line wires are used separately, and one or the other is employed, according to circumstances, the earth being used as a return circuit. After the use of one wire for the emissions of current to give the vertical motion by means of the electro-magnet, *E*, the second is used for determining the horizontal motion by means of the electro-magnet, *H*. This changing of wires is done automatically at the last revolution of the dial. Hence the dial should always be made to effect the same number of movements, whatever be the number to be inscribed. In the apparatus now under experiment in Rue de Grenelle, for example, which is constructed for 9,999 subscribers, it is necessary always to indicate a number of four figures, with the exception that zeroes may be used at the beginning. After the subscriber has thus marked the number of the correspondent whom he asks for, he has merely to push the button of the call bell, which receives its current from the central station. After the bell has been rung the telephone receiver is unhooked. If the line is already in use the subscriber hears a humming that indicates the fact to him. The receiver is hung up and the subscriber waits a few minutes before making another call.

From what has been said it follows that it is possible to bring the pins of the commutator rod into contact with all the lines of which the extremities end at the bottom, *D*. This condition alone would suffice for a number of subscribers not exceeding a hundred, but, in order to avoid the use of too large a number of these apparatus, when there are several thousand subscribers, an arrangement has been adopted by which it is possible to combine them in groups. The one actuated first seeks in one group the "thousand" demanded, and in another group the hundred and the units corresponding to the number called up. Such combination of the apparatus, which is obtained by means of the third contact pin, is analogous to that which is now made between different district offices or between the groups of the same offices. It permits of doing duty for an unlimited number of subscribers, so to speak. Nevertheless, upon the whole, although the pieces of the mechanism are not very complicated, there results, from their great number and the multiplicity of the automatic contacts that must be made, a certain complication that increases with the number of the subscribers. So, in order to begin the practical application of this system, which has given good results up to the present in the experiments that have been made with it, M. Mougeot, Under-Secretary of State, has decided that the installation should be effected in the first place in a city with but a hundred subscribers.

The apparatus is quite costly, since it must be constructed with great care; but the price is of small

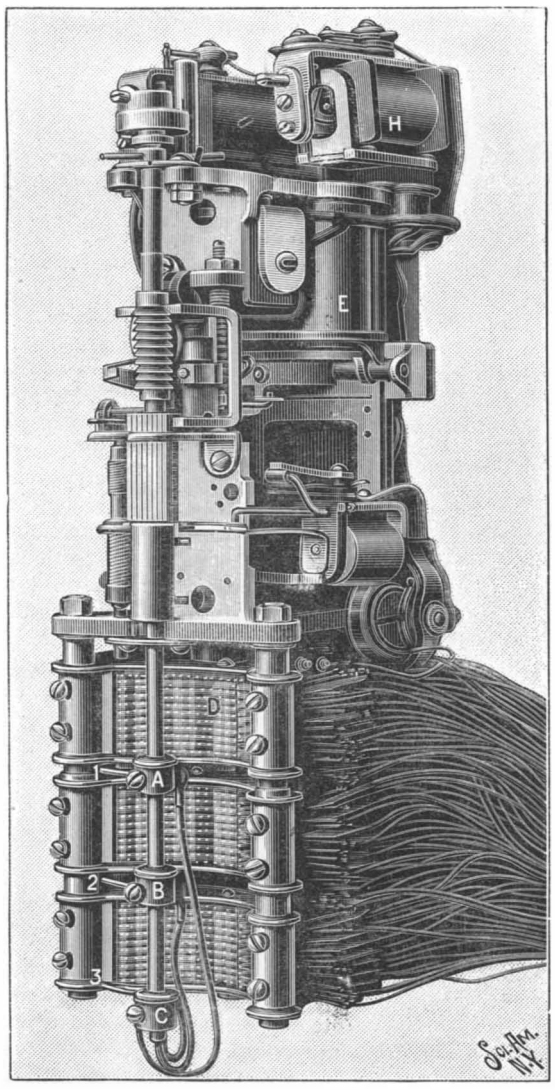

Fig. 1.—DETAILS OF A SUBSCRIBER'S COMMUTATOR AT THE CENTRAL STATION.

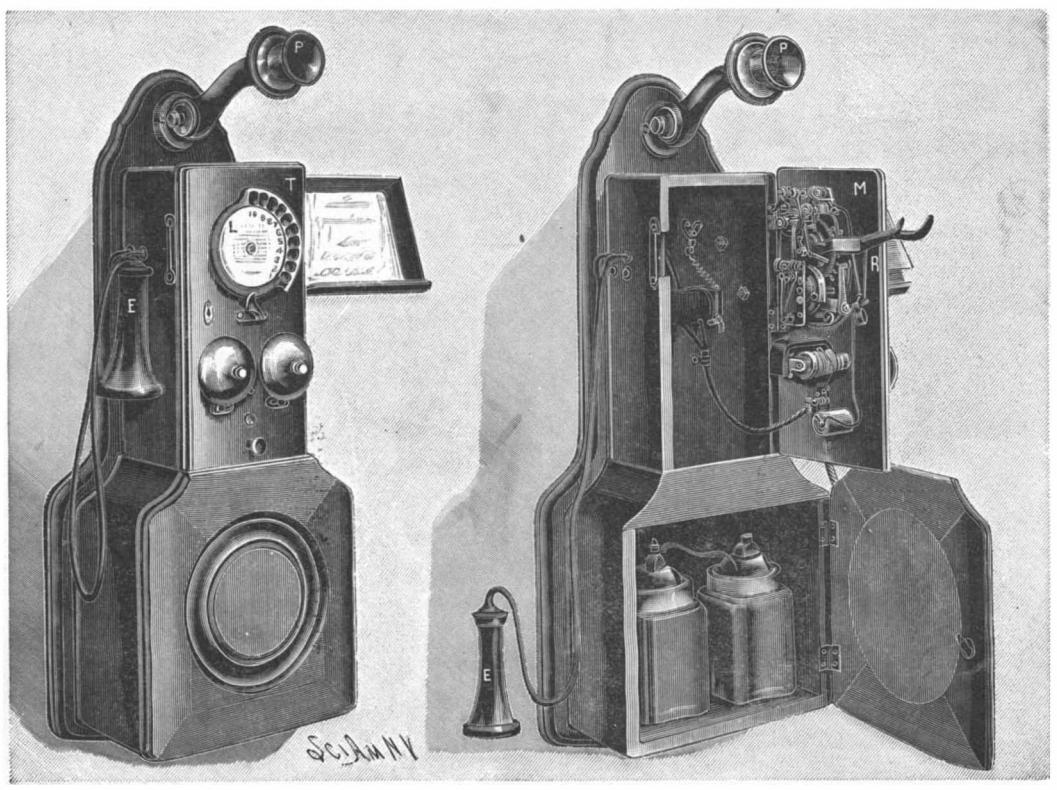

Fig. 2.—SUBSCRIBER'S APPARATUS—EXTERNAL AND INTERNAL VIEWS.

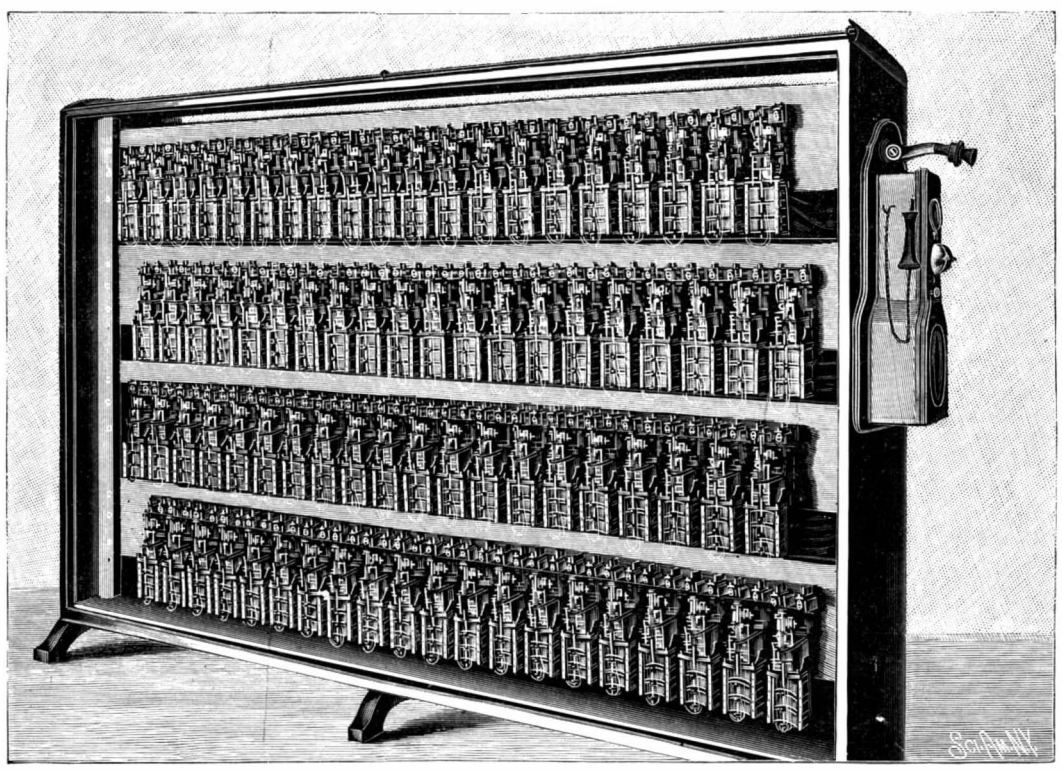

Fig. 3.—CONNECTION OF ALL THE COMMUTATORS AT THE CENTRAL STATION.

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consequence in comparison with the capital represented by the salaries of the personnel that they replace. At all events, the operation is exceedingly simple; communications are obtained with very great rapidity, and the rather acrimonious remarks that are so frequently exchanged between the subscriber and the "telephone girl" will be dispensed with.

THE HAMBURG-AMERICAN YACHT "PRINZESSIN VICTORIA LUISE."

It is now about ten years ago that the Hamburg-American Company made the experiment of sending one of their regular passenger steamers, the "Augusta Victoria," for a winter trip from Hamburg to the Mediterranean. The venture was looked upon as somewhat in the nature of an experiment, and it was undertaken partly with the object of giving employment to the vessel during the slack season of the transatlantic trade. The tour was such a thorough success that it was determined to make New York the starting point of the next trip, the results of which were such as to justify the company in instituting a regular winter service of this kind. In the earlier years of the venture, the greater proportion of the passengers were European; but of late years Americans have shown such a growing appreciation of these tours, that to-day the bulk of the passengers are taken aboard at New York city.

For some time past the directors of the company have realized that the popularity of these Oriental tours would be greatly increased if a vessel were specially designed and built for the service, and in the handsome yacht which forms the subject of our front page illustration, they have embodied all those features of convenience and comfort that have been suggested by the experience of the past decade. The "Prinzessin Victoria Luise," which has been so named in honor of the youngest child and only daughter of the German Emperor, conforms in her appearance, speed and appointments to the present accepted ideas of what goes to make up a first-class cruising yacht. With the exception, perhaps, of the new royal yacht recently built in Great Britain, she has the largest displacement of any yacht in the world, although her speed is considerably lower than that of the Russian, German and British imperial yachts. The "Queen's Yacht," as she has been called, is 420 feet long, with 50 feet beam, 18 feet draught and a speed of 20.5 knots, her displacement being 4,700 tons, or 200 more than the "Victoria Luise." The "Victoria Luise" is 450 feet in length by 47 feet in beam, with a molded depth of 30 feet, and a trial speed of 16 knots. The Russian imperial yacht "Standart" is 410 feet in length, 50 feet 7 inches in beam, has a draught of 20 feet, and a trial speed of 21.5 knots. The "Hohenzollern" is 370 feet in length, 45 feet in beam, has a molded depth of 33 feet, and a trial speed of 21 knots. The "Prinzessin Victoria Luise" is driven by twin-screw, triple-expansion engines which indicate 4,000 horse power when the vessel is traveling at 16 knots an hour. Her ordinary cruising speed, however, will be about 13½ knots an hour.

As will be seen by our engravings, she has all the characteristics of the modern yacht, such as the clipper bow, bowsprit, long overhanging stern, and ample promenade deck room. The vessel is given up entirely to the accommodation of passengers and crew. There are no second or third class accommodations, and the staterooms are loftier and more roomy than those which are found on the transatlantic service. Passengers are accommodated on three decks, known as the saloon deck, the upper deck and the promenade deck. There is also a large gymnasium located amidships between the two funnels on the boat-deck. The dining-saloon, which is on the saloon deck forward of the boiler room, accommodates a little over 200 passengers, this being the number that can be carried when the ship is completely full. A particularly pleasing feature in the saloon is a series of high-class paintings, representing the harbors of Constantinople and Sydney, and various landscapes in Germany and in North America. One of our views is taken from the gallery on the upper deck and shows the open well through this deck and the promenade deck, by which light is received from a broad glass dome above the social hall. This arrangement is similar to that on the "Deutschland," and by giving an open view through three decks it affords a sense of spaciousness which is decidedly pleasing. The upper deck is devoted entirely to staterooms, while on the promenade deck above are the social hall, library and smoking-room. The former is tastefully decorated and furnished in red, the walls being enriched with a series of beautiful paintings illustrative of scenes in the Mediterranean and the Orient. The smoking-room is finished in carved oak and the walls are relieved with numerous majolica paintings, illustrative of various aquatic sports. Agreeably to her duties as a yacht, the "Prinzessin Victoria Luise" affords a particularly spacious promenade on the promenade deck, and a novel feature, now introduced for the first time, is the provision of deck shelters, which are formed by extending aft the walls and roof of two of the deck houses, thus providing an open air shelter, where passengers can get the sea air without being exposed to wind and spray.

Immediately aft of the larger of these shelters is a space measuring about 45 feet by 50 feet, in which the hatchways have been laid perfectly flush, in order to afford a smooth dancing floor. A permanent awning framework is provided, with a view to entirely inclosing this over with canvas, and thus affording a sheltered ball-room, the orchestra being placed in the permanent shelter above described.

Another novel feature which has been carried out on quite an elaborate scale is the gymnasium, of which we present an interior view. It is fitted with Dr. Zander's system of gymnastic apparatus, of which there are fully a dozen different electrically operated pieces installed. One of these, which is known as the horse, is intended to imitate the movement of a trotting horse, vertical and slightly horizontal reciprocating movement being imparted by means of cams and connecting rods. There are also a bicycle, a form of rowing machine, and the customary chest weights, dumb-bells and Indian clubs. Most of the apparatus, however, is designed to enable the user to subject himself to more or less violent mechanical massage, the rubbing and kneading being performed by rapidly reciprocating rubber-tired wheels.

The yacht started on Saturday, January 26, for her first cruise, one of thirty-five days to the West Indies and Venezuela. She will touch at all the more important points in the islands and at La Guayra, where a stop will be made for several days' trips into Venezuela. Here it may be mentioned that on account of the great number of landings which are made in the course of a tour, the yacht is provided with two large naphtha launches, each capable of holding forty passengers, and six lifeboats which are constructed on the lines of a surfboat, to facilitate landings at points where boats of this type are required. On her return to New York, the vessel will start on a fifty-seven days' cruise to the Mediterranean and the Black Sea, and on the following May a three weeks' trip will be taken around England, Ireland and Scotland. Then there will follow two trips to the North Cape; and the season will close with a voyage through the Baltic, touching at the important points, including St. Petersburg.

Swiss Hydraulic Plant.

A new hydraulic plant is to be installed in Switzerland by a large company. The motive power of the Avancon will be utilized for a generating plant which will furnish electric lighting for the town of Besc with its numerous hotels, and for the transmission of power to various enterprises in the neighborhood. A large part of the current will be used for the new rack-and-pinion electric railway which runs from Besc to the towns of Gryon and Villars. The hydraulic plant will include a dam of 32 feet upon the Avancon, from which a canal of 4,300 feet will run underground to a reservoir, and from there a conduit of 1,200 feet leads to the turbines. The generating station will be laid out for six groups of turbines and dynamos. The head of water will be nearly 500 feet, giving 1,300 horse power at the turbines during low water, and 2,400 horse power for the greater part of the year. The installation of the reservoir and canal will be carried out by the use of "bêton armé," on what is known as the Malgarim system. The high-pressure conduit is in cast iron laid upon the surface; an overflow conduit in cement will be also provided, this being 910 feet long. The station will be equipped with six high-pressure turbines of the Escher-Wyss pattern with horizontal axes, each giving normally 400 horse power at 600 revolutions: they are provided with automatic regulators of improved type. The dynamos are direct-connected to the turbines, four of these being Westinghouse three-phase alternators giving 33 amperes per phase at 3,200 volts. The remaining two dynamos are six-pole direct current generators having a capacity of 300 amperes at 700 volts. The sub-stations will contain transformers built by the Compagnie de l'Industrie Electrique, of Geneva; from these current will be distributed for lighting and traction, using different systems of distribution according to the needs of each case. One of the main features of the system will be the supplying of small motors in the town of Besc and the surrounding district; the motors will range from 30, 12, down to 1 horse power. The electro-chemical works of Monthey will take about 900 horse power to supply three motors of the triphase type of 300 horse power each.

THE steamship "Mariposa" arrived at San Francisco January 12, from Australia, breaking the record which she had for fast time across the Pacific. The actual steaming time from Sydney was twenty days three hours; from Auckland, sixteen days twelve hours; and from Honolulu, five days eighteen hours.

Engineering Notes.

It is estimated that the dense fog in London costs the city from $250,000 to $500,000 daily in the matter of bills for gas and electricity.

A new bridge is being planned for the Bosphorus. The designs which have been prepared are extraordinary. Each tower is surmounted by what appears to be a mosque with domes and minarets.

The Erie Railway is remodeling its passenger terminal facilities in Buffalo, in view of the business which will undoubtedly accrue to it, as well as other lines which enter Buffalo, by reason of the coming Pan-American Exposition.

Senator Hoar has introduced a bill into the Senate making train robbery in the United States and its territories punishable with death. A similar bill has been introduced into the House of Representatives by Chairman Ray of the House Judiciary Committee.

A company has been organized to build a railroad from Vancouver eastward through the Kootanai mining district. The government of British Columbia will probably give a subsidy of $4,000 per mile for 330 miles. The country to be opened by the new road is one of the richest in mineral wealth in British Columbia.

The steamship "Hawaiian," of the American-Hawaiian Steamship Company's fleet, has just arrived at Philadelphia. This is one of the seven vessels of the new line which will run between New York, San Francisco, and Honolulu. The steamer is 435 feet long, 51 feet beam, and 33 feet depth. The gross tonnage is 6,000, and the cargo capacity is 8,250 tons.

A colossal ferry bridge is to be erected over the River Tyne at the harbor mouth, connecting North with South Shields. The bridge will be similar in design to that erected at Bizerta in Spain. The suspension bridge will be erected at a height of 270 feet, and will have a clear span of 640 feet, so that even the largest vessels may be able to pass up and down the river with facility. From the bridge will depend a platform, suspended upon cables, which will have accommodation for tramcars, horses, vehicles, and 200 passengers. The mechanism of the bridge will be actuated throughout by electricity.

A curious fire broke out in the coal storage yards of the British Admiralty at Portsmouth recently. The Welsh steam coal reserved for naval purposes is stored in huge heaps, each containing many thousand tons. One of these heaps evinced signs of spontaneous combustion. No flames were visible, but copious volumes of smoke were emitted. Fortunately, there were several dockyard hands on the spot, and the fire was soon extinguished. The authorities, however, are constantly encountering trouble of this description. After periods of prolonged wet weather, such as England has been recently experiencing, these heaps ignite through spontaneous combustion, because the Welsh coal is highly inflammable. During the past few months no less than three such outbreaks have occurred, only they have been attended with much more serious results than this last conflagration, since several hundred tons of coal were consumed before the flames were extinguished. The naval authorities intend to store the coal in large inclosed depots, the building of which is now in rapid course of construction, so as to obviate further trouble of this description.

The high price of coal in England has had the effect of attracting attention to the vast wealth of this product in the colonies, especially in Australasia, and determined efforts are being made to place the article upon the English market. The progress made in this industry in New South Wales and Victoria during the past few years has been remarkable. Australia possesses extensive areas of coal-bearing territory, and up to the present over 100,000,000 tons have been produced for the world's markets. Last year alone no less than 6,000,000 tons were exported from the collieries in New South Wales. Hitherto the industry has been handicapped by the inefficiency of the transport service by which to convey the material to the coast, but now that railways are rapidly developing through the various colonies numerous collieries are being established. In Victoria seams varying from 2 feet to 5 feet in thickness are found in abundance, and in some districts where boring operations have been carried out, it is computed that nearly 60,000,000 tons are available. The coal is specially recommended for steaming purposes, since it emits only a minimum of light smoke. It practically costs nothing to mine the product, since it lies so near the surface and in some instances the coal beds, averaging 70 feet in thickness, are worked as a quarry with open face. It has been seriously considered by the British Naval Department whether this fuel could not be requisitioned for naval purposes, in which event it could be more expeditiously and more economically utilized for stocking the naval bases in the East, and in the Antipodes. Should the suggestion be affirmed it will have the effect of stimulating the industry considerably.

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Correspondence.

An Invention Wanted.

To the Editor of the SCIENTIFIC AMERICAN:

In this country there is great need among the stockmen for some effectual way to burn fire guards. I myself want to burn fifty miles of fire guard this coming season. Now the grass in this country is usually very short, and when an attempt is made to burn guards by means of torch and oil or by dragging a rope which has been soaked in oil and then set on fire, the result is usually not satisfactory. What we need is something that can be drawn over the ground that will burn the grass little or big, for a width of from eight to ten feet, whether the wind is favorable for such work or not. If such a thing could be devised which would not cost too much, I believe a large number could be sold in this country, as I have heard many stockmen say they would like to have their entire stock ranges surrounded with a properly burned fire guard. A man here has built a machine for this purpose which sets the grass on fire by means of gasoline gas, and trailing behind are steel brushes to put out the fire. This, I understand, is quite a success, but it costs so much no one will buy one. Now, my idea is to have merely the best possible device to set the grass on fire to a width of say eight feet, and depend on men to follow it and put out the fire if it spreads beyond the limits desired. As an idea of what would meet our needs, I will say the man who can make the points or ends of every tooth in an old horse hay rake a flame of fire can find a good market for his device among the stockmen here, who want to burn fire guards around their stock ranges. A. K. PRESCOTT.

Helena, Mont., January 26, 1901.

The New Protected Cruisers of the "St. Louis" Class.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 22, page 393, there is an article on the new semi-armored cruisers of the "St. Louis" class. Undoubtedly the design embodies many excellent features, but it would seem that they are rather inferior to some other cruisers of the same size. So many cruisers are now built with ample protection of 6-inch Krupp armor, against which the 6-inch rifle is quite powerless at ordinary ranges, that the new cruisers would certainly be at a great disadvantage in an engagement. The displacement is somewhat greater than that of the "Brooklyn," the speed, armor protection, and bunker capacity about the same; but the armament is certainly inferior. What advantages, then, do the new cruisers possess to offset their inferiority—for inferior they certainly are—to the "Brooklyn"?

Of course, the 6-inch rifle is far more powerful than the 5-inch, the rifle carried on the "Brooklyn;" but 14 6-inch rifles are assuredly not as powerful an armament as 8 8-inch and 12 5-inch guns.

Comparing them with foreign cruisers we observe the Japanese armored cruiser "Asama," recently completed at Elswick. This admirable vessel has the same displacement as our new cruisers of the "St. Louis" class; the same speed, the same bunker capacity; but far exceeds them in armor protection and armament. She carries a complete water-line belt of 7-inch armor, an upper belt 5 inches thick, casemates 6 inches, and turrets 8 inches thick; and an armament of 4 8-inch rapid-firers, and 14 6-inch rapid-firers; while our cruisers rely upon a partial 4-inch belt amidships, an upper belt of 4 inches, and a main armament of only 14 6-inch rapid-firers. The only item wherein our cruisers are superior is in the secondary battery; but this certainly cannot offset their other discrepancies.

Comparing them with other foreign-built vessels, for instance, the new Italian cruisers of 8,000 tons, or the "Esmeralda" of the Chilian navy, we find even greater discrepancies. The new Italian boats are to steam 20 knots an hour, are well protected with 6-inch armor, and carry an overwhelming battery of 12 8-inch rapid-firers—almost as many 8-inch as our vessels carry 6-inch. The "Esmeralda" carries, if my memory serves me right, 2 8-inch rapid-firers and 16 6-inch rapid-firers. Certainly this is enormously superior to our cruisers. But the latter may not after all be so overwhelmingly superior as it appears to be on paper, for I think that it is frequently charged that the "Esmeralda" is one of the "show vessels" built by the Armstrongs, and that many essential features have been sacrificed to secure the abnormally large battery.

Although our boats possess many good features, on the whole they are certainly inferior to the "Asama," the Italian cruisers, or even our own "Brooklyn."

It may be said that they are only intended for protected cruisers and not for armored vessels. But one is forced to ask what is the advantage of building a protected cruiser, inferior in speed, coal capacity, and armament to armored cruisers of the same or even smaller size. Certainly it would be far more sensible to give them more armor, speed, and armament, and call them regular armored cruisers. If the "Brooklyn" is classed as an armored cruiser, certainly the "St. Louis" should be, for the latter carries considerably more armor than the former. So I think I am justified in the view that I have taken of them, i. e., as armored cruisers.

A similar criticism, viz., that of carrying too weak an armament, may be made on the armored cruisers of the "California" class. On a displacement of 13,800 tons—4,000 tons more than the "Asama"—the only superior feature is a bunker capacity, greater by 500 tons. It seems to me that an armament of 8 8-inch and 14 6-inch, 4 8-inch and 14 6-inch respectively, and a speed of 23 knots, would be far more suitable for our new cruisers.

The vessels of our navy have always been noted for their powerful batteries; but it would seem that we are not keeping up to the standard set by our early boats, and even by our new battleships of the "Georgia" and "Rhode Island" classes in that regard.

Possibly those of your readers who, like myself, are interested in naval matters, would like to know what reasons exist for giving our cruisers inferior armaments in spite of their great size.

Pacific Grove, Cal. GEORGE HOOLE.

[Our next issue will contain another letter on this subject, and Admiral Hichborn's reply to the questions raised in these two communications.—ED.]

Automobile News.

The public vehicles of the Parisian Cab Company have been withdrawn from use. The maintenance of the vehicles was excessive, costing $3 a day, and as the charging station was three miles from the Opera, where the main stand of the cabs was located, there remained only a capacity of 22 miles in the batteries.

A resident of Bangor, Me., has invented a self-propelled sled which he has called an "automosled," says The Electrical Review. When completed the machine will be 10 feet long, 3 feet high, and 4 feet wide.

A collapsible bucket for automobiles is made by a Boston firm. It is made of rubber, and is provided with a strainer so that water can be taken from any source. It proved very useful for automobiles, as it can be folded up and carried under the seat cushion.

The new Back Bay automobile omnibuses are proving very successful. They stop wherever signaled, irrespective of street corners, which is much appreciated by the lady patrons. They can be signaled from the house windows, and thus the necessity of crossing the street is avoided. In the five hours of the first experimental day one vehicle carried over 70 passengers, and the three carried 175.

The automobile season at Nice will present a number of interesting events. The "Grande Semaine," the week of automobile fetes, will commence on March 25 and last until April 1. Besides the events included in this programme, a number of races will be held under the direction of the Automobile Club of Nice; no less than seven cups have been offered to the club by different persons, and great preparations are now being made for the races. These events, in the order of their dates, are as follows: The Luiski cup, January 21, for road wagons, will be run from Cagnes to St. Victor, over a hilly road. The De Bary cup, January 27; this will be run in two stages, the indication of the route is reserved until the time of starting. The Brunetta d'Usseax cup, March 25. The Baron Arthur de Rothschild cup will be run on the 12th of March over the route from Nice to Turbie. It is for large machines only, for at least four persons, weighing (voyagers included) over 3,300 pounds. The starting point will be at the foot of the slope of the route from Genoa to Nice (altitude 0) beyond the junction with the Turin road, and the end will be at a distance of 5.4 miles, at an altitude of 1,600 feet, thus requiring some hill climbing. The engagements will be received up to the 9th of March by the Automobile Club of Nice. The machine making the best time will gain the cup, and the second best will receive a silver medal offered by the club. A full set of rules has been published. The next event is the race for the Lebaudy cup, March 17, for carriages weighing over 990 pounds. It will start from Cannes, following the route Frejus, Hyères, Cuers, Le Luc, Frejus, Cannes. The rules for the Baron Henri de Rothschild cup have also been published. The race is fixed for the 28th of March, and is open to all vehicles weighing more than 1,320 pounds and carrying two persons. It is a speed race, and will be held on the cemented racetrack of the Promenade des Anglais; the distance will be 0.6 mile (1 kilometer). Only the machines making the distance in less than one minute will be counted. This is a challenge cup, and will be competed for each year at the same period. Engagements will be received by the club until March 27. The last event of the series is the Nice cup, March 31. This is the second year for this cup; it was won last year by M. Pinson.

Electrical Notes.

Old horse cars are being used for curious purposes. In Chicago one of the old cars has been mounted on a scow and transformed into a houseboat.

Telephones are to be added to the fire alarm boxes of London. The firemen will carry receivers in their pockets, and the handle of the alarm box will be made into a transmitter.

The Ostend boat, "Princess Clementine," went ashore January 19, in a fog. She sent word by wireless telegraphy to Ostend for assistance, which was promptly sent. She was floated off at high water, and arrived safely at her destination.

It is said that Benson Bidwell, of Hartford, will bring suit in many of the United States district courts against electric railroad corporations for the infringements of patents. He claims that fifteen years ago he evolved a system of applying electricity to trolley car propulsion identical with the system now in use, and that he has never received any royalties for his patent.

A fast trolley car is being tested in Philadelphia. It takes newspapers in the early morning to Chestnut Hill, 14¾ miles away. It runs at a rate of 35 miles an hour, including a stop at least every three-quarters of a mile. Occasionally it has run a mile in a minute and an eighth, and it has made the entire distance in twenty-five minutes, including stops, which is the same time as the express trains make for the same distance. It maintains its schedule time regularly, but on one occasion it was late ten minutes, owing to the wreck of a hay wagon which was on the road. It is an experiment made by the Union Traction Company to test the maintenance of high speed and the evenness of schedule time. Every trip is carefully watched by experts—the state of the metal, the thermometrical and barometrical conditions being noted, as well as the humidity and fog at the various stations. Automatic instruments for recording the speed, etc., are arranged on the back platform. The weight of the car, newspapers and four persons occupying it is 10½ tons.

According to Prof. J. A. Fleming, of the University College, London, Marconi has accomplished a remarkable performance with his wireless telegraphic system. The experiment was carried out between the two stations, Poole on the English coast, and St. Catherine's on the coast of the Isle of Wight, a distance of about thirty miles. Instructions were given to the operators at the St. Catherine's station to dispatch simultaneously two different messages to Poole. At the latter station two receivers corresponding to the transmitters at St. Catherine's were placed in position upon independent aerial wires, and without the slightest delay or mistake the two messages were received at Poole simultaneously upon the respective receivers. Marconi then superimposed the two receivers at his station at Poole, and connected them to a single wire about forty feet in length, which he attached to the mast. Two other messages were then transmitted from St. Catherine's station as before, only in this instance one message was dispatched in the English language, and the other in French. There being only one receiving wire at Poole connected with two receivers, it would be naturally expected that the received messages would result in a mixture of English and French words. Instead of this, however, when the tape machine rolled out its record at the Poole station, it was discovered that two messages were printed thereon, one in English, and the other in French.

The Baldwin Polar Expedition.

Evelyn B. Baldwin sailed for the United States January 26, having practically completed his arrangements for his coming Arctic expedition. He chartered the steamer "Frithjof," of Christiania, which was used by the Swedish Polar Expedition last year. The "Frithjof" will leave Christiania about January 20, taking to Franz Josef Land the equipment and provisions for the expedition. The steamer "America," which Mr. Baldwin bought at Dundee, will proceed to some point off the north coast of Russia, for the purpose of taking on dogs and supplies. The "America" will proceed thence to the designated point off Franz Josef Land where the "Frithjof" is expected to meet her.

Pure Helium.

Prof. Dewar, in a recent lecture before the Royal Institution, expressed his disappointment that the experiments in the laboratory of the institution had failed to produce pure helium. He said that he longed to find a rich man generous enough to supply funds necessary for the discovery of pure helium; the expenditure would be very great. It is said that his discovery would enable the realization of Lord Kelvin's idea that a temperature within five degrees of absolute zero can be reached. He also said that he did not know why the reaching of absolute zero should be regarded as hypothetical.

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WHAT CAN BE MADE OF ORANGE PEEL.

It is related that a Chinese artisan of Canton, named Lim-Kao-Poung, who lived two hundred years before Christ, made a minute junk out of a dry bean pod. It was a masterpiece of skill and precision. The junk was provided with a rudder, cabins in the rear, a mast with its rigging, and a crew. Upon the exterior of the hull were engraved several sentences from Confucius. In order to recompense the maker, the Emperor, Tsi-Fou, awarded him 1,000 taels.

A number of objects, of which the manufacture does not require as much patience as the junk did, nevertheless resemble it in one respect, that is to say, in the abundance of the material of which they are constructed and the skill that has to be put to the test. Such are collars of carved filberts, chains of cherry pits cut out into rings, apricot pits metamorphosed into cocks' or parrots' heads, baskets made of horsechestnuts, etc.

Small and very interesting objects can also be made of orange peel. The materials for the purpose are simple, and consist merely of a very sharp penknife and a few splints of wood of different lengths.

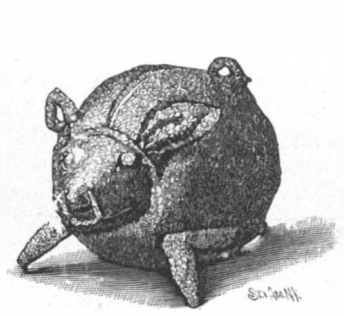
Let us take an orange, says Lectures pour Tous, our French contemporary, and make four incisions in it at right angles, starting from near the base. With the thumb nail inserted under the rind, let us separate the latter from the fruit without tearing it. We thus obtain four quarters of peel united at the base. Now let us cut these quarters into thin strips by strokes of the knife blade given alternately from the free summit of the quarters to their point of junction, and from this point to the summit, in taking care each time to stop at a short distance from the extremity. We thus form a ribbon interrupted by four small lozenges, and obtain an entanglement of narrow strips. Let us arrange these upon the orange and wind a strip of the rind into a spiral and support it by a splint of wood thrust into the top of the orange. In this way we obtain an object that has somewhat the aspect of a pile of rocks upon which formidable serpents are erecting themselves in menacing attitudes.

If it be desired to obtain an animal less frightful than a serpent, carve the top of an orange, and here and there raise up a few bits of the rind, so as to form two pointed ears, four legs, and a little twisted tail; and, behold, we have a young porker that appears to be upon the point of grunting.

Not content with being a carver of animals, the artist in orange peel may raise himself to the dignity of a portraitist. See this simple fellow who comes into being in measure as the knife indicates his two round eyes, his flat nose, his widely spaced ears, and his thick lips. It would be possible in two minutes to form in this way the portrait of an old woman with her cap and spectacles, a clown with toupet and wig, or an old bewhiskered sailor smoking his pipe.

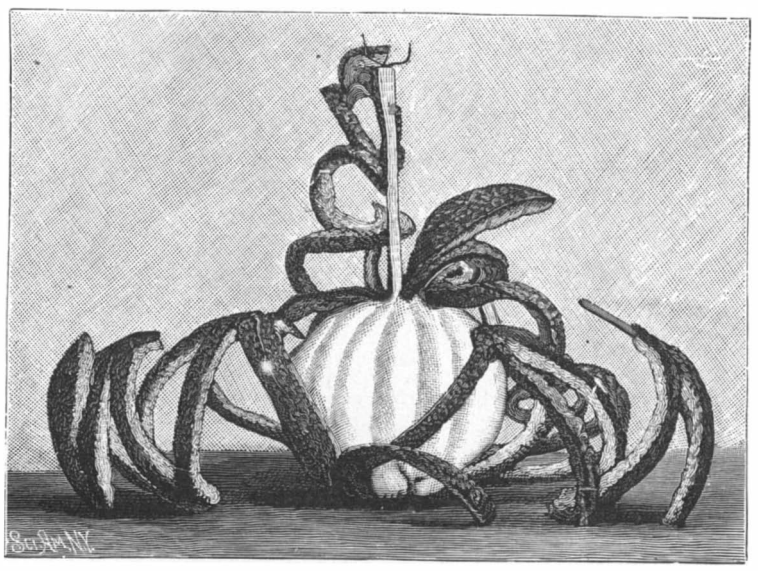
If a bouquet be desired, there is nothing easier than to make it. Place an orange upon a vase, and, in the entanglement of the strips of rind, insert here and there a few pansies, the beautiful, velvety tints of which harmonize well with the warm colors of the orange.

HOW TO CUT THE PEEL OF AN ORANGE.



A YOUNG PORKER.

A PORTRAIT IN TWO MINUTES.

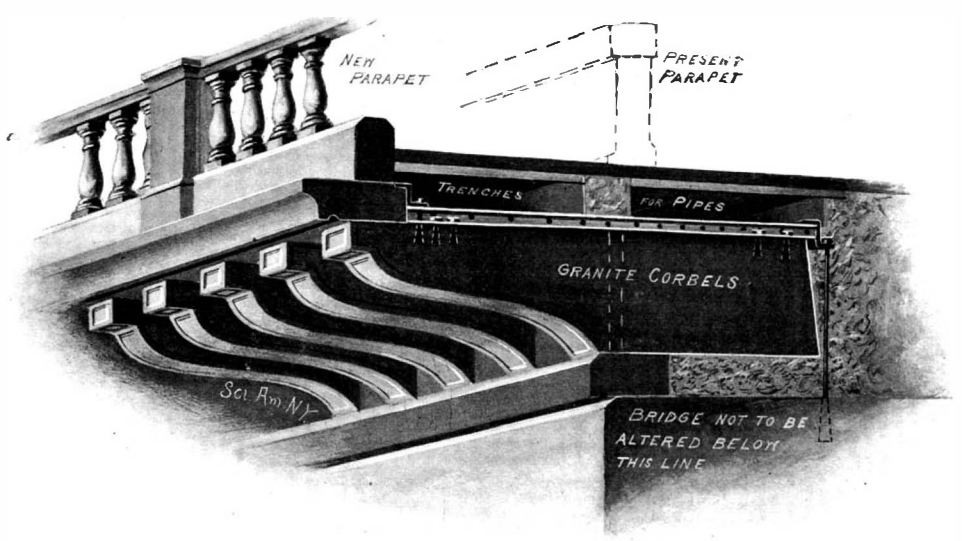


A ROCK OVERRUN WITH SERPENTS.

THE PROPOSED WIDENING OF LONDON BRIDGE.

As far back as the year 1800 a committee, in reporting the condition of the old London Bridge, recommended that this ancient structure, being no longer able to discharge its duties with proper regard to the safety of the public, should be removed. In its place was erected the present handsome stone structure which constitutes one of the best pieces of work carried out by the celebrated Rennie. The work on the structure was commenced in 1824, and it was opened for traffic in 1831. After twenty-two years of successful service, the great increase in traffic, both pedestrian and vehicular, which was due largely to the close proximity of the railway station to the approaches on the Surrey side, led to the consideration of plans for increasing its carrying capacity. From the year 1853 to the present time there has been a constant agitation of the question, which not even the opening of the Tower Bridge, half a dozen years ago, served to subdue. The first proposed scheme of enlargement, in which the width of the bridge was to be increased to 83 feet, was abandoned in consequence of Sir Benjamin Baker's opinion that it would be unsafe to extend the present foundations.

The present plan of widening the bridge, which is certain to be carried through, contemplates the lateral expansion of the whole bridge from 53 feet 5 inches to a width of 65 feet. The enlargement will consist of a widening of the footwalks on each side of the bridge. This will be effected by means of granite corbels, or cantilevers, which will be 10 feet in length over all, 13 inches in depth at the outer end, and 2 feet 9 inches in depth on the inner half, which lies within the face of the present bridge, and will be built solidly into the masonry. The embedded portion is 4 feet 6 inches in length. Upon the upper face of these corbels and extending their full length will be bolted a 6-inch by 3-inch steel tee, and the connection will be reinforced by a 3 inch by 2½-inch steel angle at the inner end, which is riveted to the T and connected with the main structure of the bridge by long 1-inch bolts, which will be carried well down into the masonry. At the outer end a clamp, measuring 12 inches by 3 inches, and 1 inch in thickness, will be bolted to the tee, and will extend up and over the inner edge of the cornice. With a view to reducing the total weight on the outer edge of the extended footwalk, the present solid parapet will be removed, and an open balustrade, of the kind shown in our illustration, will be substituted. Some objection has been raised against this alteration on the ground that it will not harmonize with the rest of the design, and we agree with our contemporary, The Engineer, to which we are indebted for our information, that the *tout ensemble* of this handsome bridge will be in nowise impaired by the change. The cost of the entire enlargement is estimated at about $500,000.



PROPOSED SCHEME FOR WIDENING LONDON BRIDGE.

Silkworm Gut for Fishing Lines.

The production of what is known as silkworm gut for fishing lines is a curious industry, says The Textile Record. It has followed the decline of silk culture in the vicinity of Murcia, Spain. The grub is fed as usual on mulberry leaves, but before it begins to spin is drowned in vinegar, and the substance that would have formed the cocoon is drawn from the body as a thick silken thread. The thread is treated with chemicals, dried, and put up in bundles of 100.

Lucrative Patents.

The Century Magazine recently had an interesting article on our patent system, and possibly the most interesting section of it is that which relates to the success which has crowned the efforts of many inventors of novelties and labor-saving inventions. We quote as follows:

"Every one has heard not only of the enormous sums realized from the great inventions of the last half century, but also of the large returns yielded by things apparently trifling which have struck the public fancy or met the public need. The toy called the returning ball, a small ball attached to an elastic string, is said to have produced a profit of $50,000 a year; the rubber tip on lead pencils has yielded a competence to the inventor; more than $1,000,000 has been earned by the gimlet-pointed screw, the inventor of which was so poor that he trudged on foot from Philadelphia to Washington to get his patent; the roller skate has yielded $1,000,000 after the patentee spent $125,000 in England fighting infringements; the dancing Jim Crow is set down for $75,000, and the copper tip for children's shoes at $2,000,000; the spring window roller pays $100,000 a year, the needle threader $10,000 a year; from the drive well $3,000,000 has been realized; the stylographic pen is credited with $100,000 a year; and the egg beater, the rubber stamp, and the marking pen for shading different colors with large sums. These are only a few examples among hundreds that might be cited. No wonder inventors are hopeful when they reflect that comfort for life and fortune for their children may come from a single fortunate idea."

The Mosel-Saar Canal of Germany.

The Germans are persistently improving their canal system. The latest scheme relates to the winding Mosel, which begins in France and ends its course at Coblenz, where it empties into the River Rhine, a total distance of 514 kilometers (319 miles) by water, but in a straight line only 274 kilometers (170 miles). The proposed scheme will embody a length of about 200 miles and a level difference of 340 feet. The Mosel at its source is 735 meters (2,411 feet) above sea level, and at its junction with the Rhine 98 meters (198 feet), the main incline in the river bed being in the upper course. To get over this difference of 340 feet forty-two needle weirs are planned. The cost, apart from the harbors, is estimated at nearly $15,000,000. The scheme would also involve the straightening of about 40 miles of the Saar, which is a tributary of the Mosel; and this would bring the cost to about $18,000,000. The whole question was discussed at a special meeting held in Metz in the latter part of last June. Although the scheme would rival the Rhine-Elbe Canal, representatives of the Westphalian Coke Syndicate have given it their support. Like Westphalia Lorraine and the Saar district owe their development chiefly to the iron and coal industry, though cement and brick making are also important.

The Center of Population in the United States.

The center of the population in the United States is now at a point in latitude 29 deg. 9 min. 36 sec. north and longitude 85 deg. 48 min. 54 sec. west, which point is in southern Indiana about seven miles southeast of the city of Columbus. Since the last census of 1890, the center of population has moved westward about fourteen miles and south about three miles.

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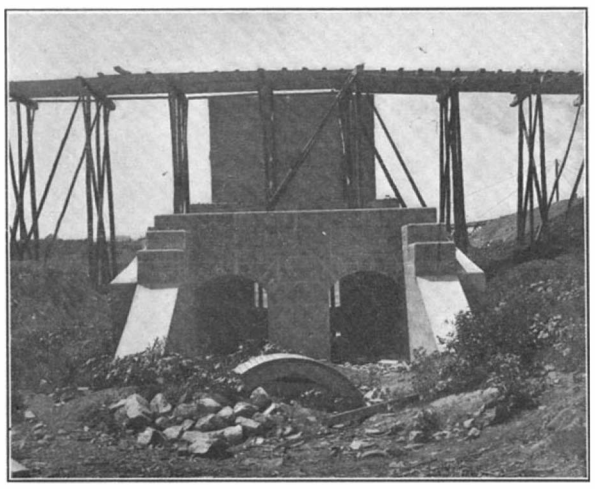
THE CANALS OF CANADA.

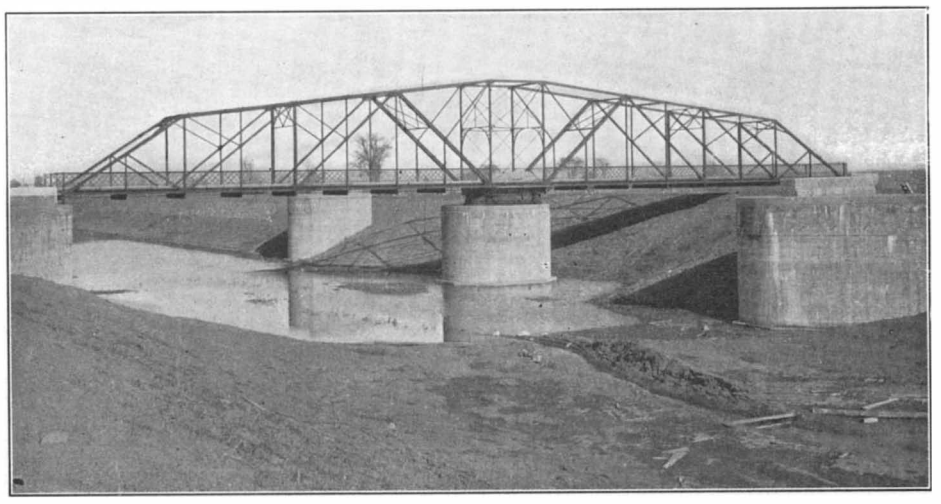
BY WALDON FAWCETT.

The tremendous commercial and industrial development which has lately been inaugurated in many different directions in the Dominion of Canada is chiefly and directly traceable to the opening of the system of enlarged canals, which has made possible the introduction of vessels of moderate draught in the trade of what is known as the St. Lawrence route. It has been realized for some years that Montreal and other points on the lower St. Lawrence River presented admirable facilities as export ports for grain, just as it has been appreciated that the iron industry of Canada needed little fostering to yield rich returns; but activity in both directions has been considerably retarded by inadequate facilities for water transportation.



SLUICES ON LINE OF ST. LAWRENCE CANALS.

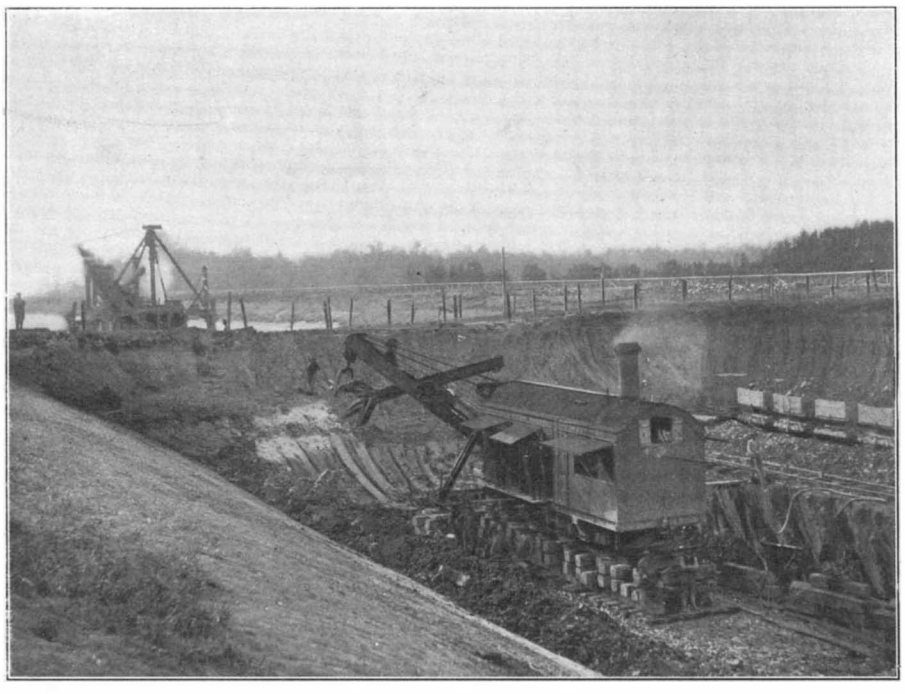
That the importance of a waterway linking the Great Lakes and the Atlantic, and the benefit which it would confer, not alone upon Canada, but upon the entire region bordering on the Great Lakes, has been realized, is attested by the immense interest which has been manifested in the investigations of the Deep Waterways Commission appointed by Congress a few years ago to compare the advantages of the various routes, exclusively in American territory, for a navigable channel from fresh to salt water. Canada has felt the necessity of such an avenue of communication far more keenly than the United States; for not only has she practically no shipping on the Great Lakes, but almost the only outlet for the product of the grain fields of Manitoba—one day to become the greatest cereal-producing region in the world—has been found in rail lines, which by reason of meager competition have been disposed to offer few advantages to the shipper. On the other hand, however, Canada had what the United States with its immense lake fleet and network of railroads had not, a natural waterway to the coast, which with a moderate expenditure could be adapted to the traffic of ships of fair size throughout its entire length.



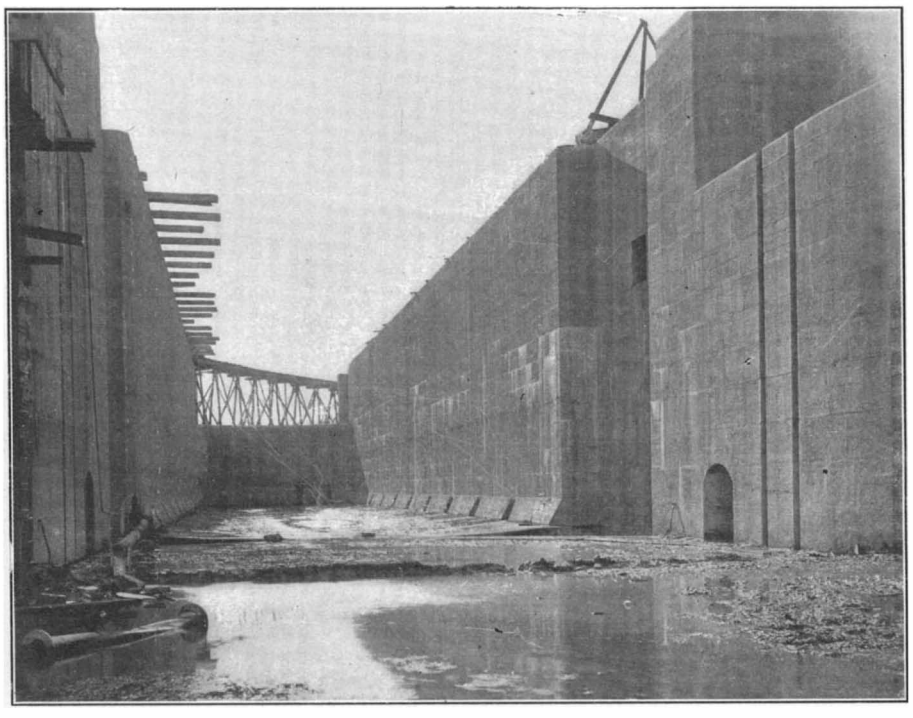
TYPE OF HIGHWAY SWING BRIDGE IN USE ON THE ST. LAWRENCE CANALS.

Although the Canadian system of canals has only just been brought to the point where it is proving a factor in the utilization of the natural resources of the country, the Dominion government has, since Confederation in 1867, spent more than $75,000,000 on the various canal systems, the backbone of which is of course the Welland and St. Lawrence waterways. These two systems, together with those portions of the St. Lawrence River where no improvement has been necessary and the chain of Great Lakes and their connecting rivers, gives to Canada what is unquestionably the most remarkable uninterrupted course of inland water communication in the world, a stretch of almost 2,400 miles extending from the Straits of Belle Isle to the ports at the head of Lake Superior.

The project of a Canadian waterway of a uniform depth of 14 feet, extending from the Great Lakes to the Atlantic coast, was first seriously considered in 1872, and it is probably due largely to the fact that plans prepared about a quarter of a century ago have been carried out without alteration or amendment, that the canals just completed were not made somewhat deeper. At the time the scheme was first mapped out the immense, steel, freight-carrying steamers now in service on the lakes were unthought of, even as a remote possibility, and it was supposed that a channel capable of accommodating vessels drawing 13 or 14 feet of water would meet all the requirements of any trade which might be developed in this part of the continent. Long before the system was completed the Canadians discovered their mistake, but it would have

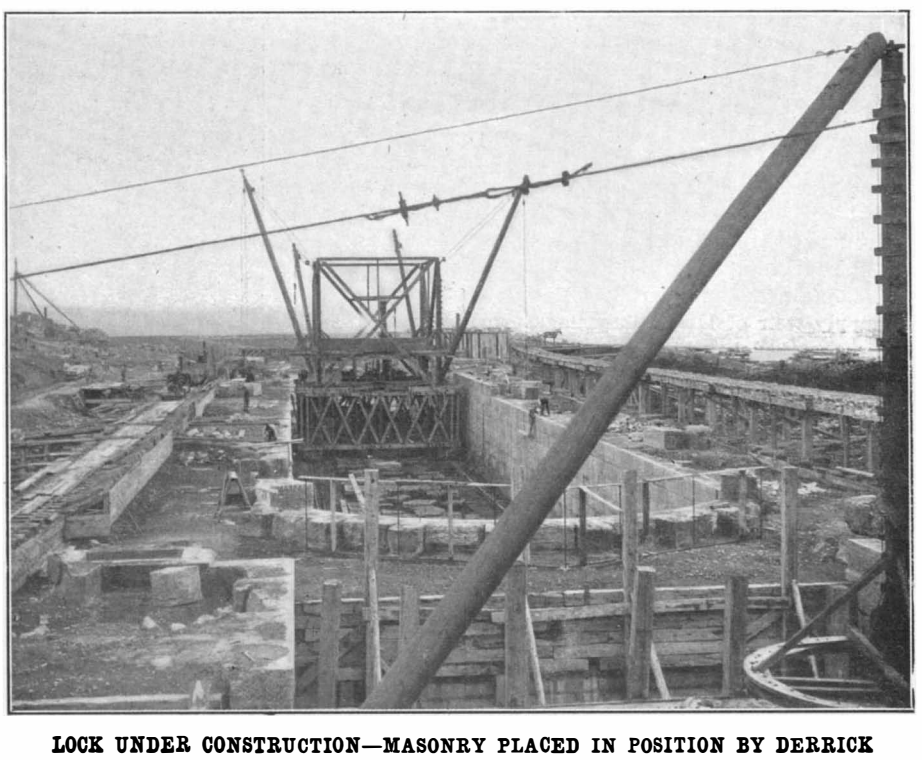


STEAM SHOVEL AND FLOATING DREDGE AT WORK ON CANAL.



VIEW TAKEN IN INTERIOR OF ONE OF THE LOCKS.

AQUEDUCT FOR CONVEYING GRAISE RIVER UNDER THE SOULANGES CANAL.



LOCK UNDER CONSTRUCTION—MASONRY PLACED IN POSITION BY DERRICK TRAVELING ON FLOOR OF DOCK.

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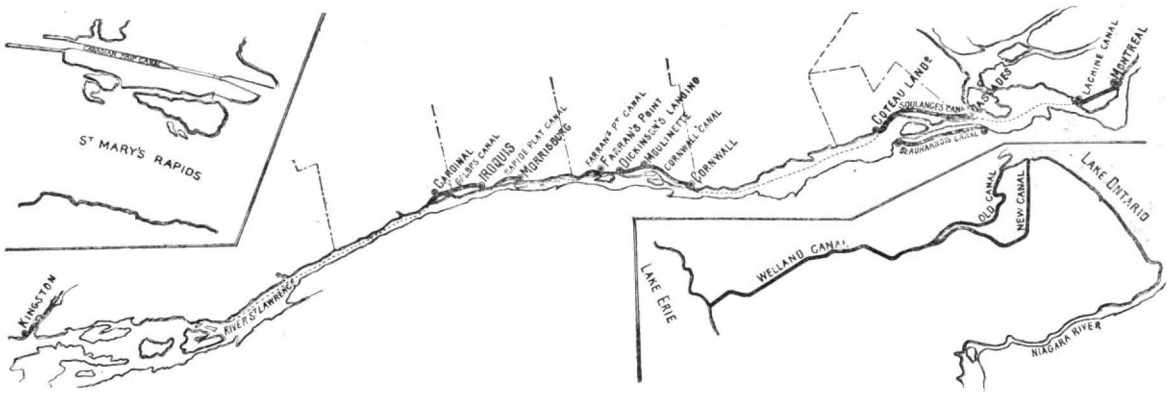
been manifestly useless to make the new canals deeper unless a like improvement could be introduced in those first constructed, and so the original uniform depth was adhered to.

The St. Lawrence system proper consists of six canals, ranging in length from one to fourteen miles. With the Welland Canal, which goes to make up the seven artificial waterways between Lake Erie and the sea, the canals have an aggregate length of over seventy miles. In this distance there are 53 locks, overcoming a height of 533 feet. To bring the locks to their present uniform dimensions of 270 feet in length and 45 feet in width, more or less extensive alterations had to be made on each one; nor did a single one of the half a hundred locks have, originally, the desired depth.

The canal system of the St. Lawrence River is necessary to enable vessels to make the ascent of 207 feet from the level of the river at Montreal to Lake Ontario and to avoid the dangerous rapids which are found at various points. The menace which these have constituted to navigation interests has been well illustrated by experiences during the interval when the improvements on the canals were uncompleted. Upon occasions when the demand for lake-built craft for Atlantic coast service was urgent, the Standard Oil Company and other interests allowed several vessels which were of too great draught to pass through the canals to "shoot the rapids." This proved an extremely hazardous proceeding, and several of the craft were either lost or seriously damaged.



MAP SHOWING THE CANADIAN SYSTEM OF LOCKS AND CANALS ON THE GREAT LAKES AND THE ST. LAWRENCE RIVER.

The largest, the most lately completed, and decidedly the most interesting canal of the St. Lawrence system is the Soulanges, which in the details of design and construction may be taken as typical of the most approved practice in waterway construction in the Dominion. The Soulanges is fourteen miles in length, and not only overcomes the difference of 82 feet between the levels of Lake St. Francis and Lake St. Louis, but enables vessels to avoid sixteen miles of dangerous rapids. This canal cost $5,250,000, is operated by electrical power, and is claimed in point of equipment to be the most modern in the world. Vessels may traverse the waterway by day or night, and it is a remarkable fact that the canal has only two curves and that the entire fall of 82 feet is overcome by four locks.

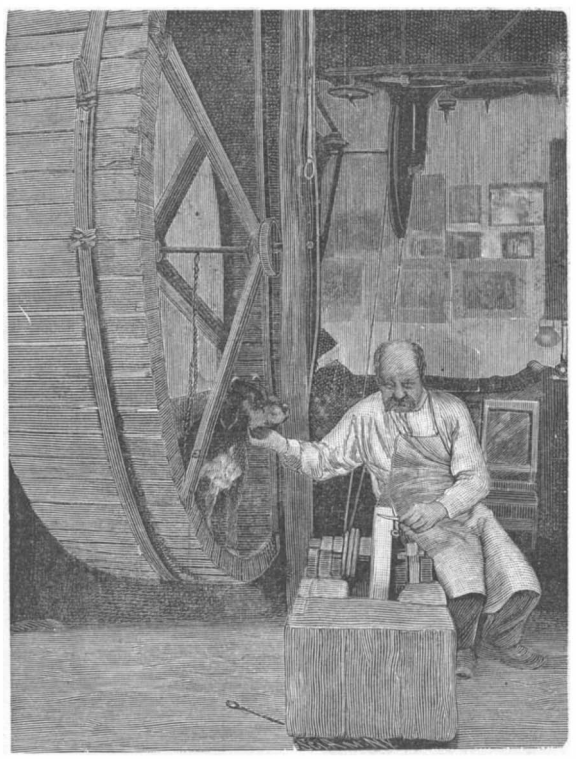
One of the chief points of novelty in the Soulanges is the introduction of concrete to a large extent in the walls and foundations of the locks. In the locks of the Welland and most of the other Canadian canals the backing is of masonry, but in this latest canal the mass is concrete faced with stone. Each of the locks has a lift of 23½ feet and is 350 feet in length, 46 feet wide and 42½ feet high. At the upper end there is a breast wall about 23 feet high of solid masonry. The water to fill or empty the lock is conveyed through tunnels in the side walls which are 25 feet apart at the base. Control is effected by means of sluices, placed in wells behind the recesses for the gates, and operated from the coping of the locks. From the tunnels the water is introduced to the chamber of the lock by twenty cast iron pipes, each of 2½ feet diameter, ranged ten on either side. The means of escape is, of course, by the same avenue. The lock is filled in about five minutes, and under ordinary conditions a lockage can be made in from 12 to 15 minutes.

The question of the provision of an adequate water supply in all parts of the canal at all times has been solved by the provision of commodious side channels. At the intake at Lake St. Francis the water designed to maintain an uninterrupted flow is passed through a supply weir of large dimensions provided with four sluices and debouching into a channel or raceway behind the guard lock. This is continued to the lower end of that structure, where it joins the main canal. The sluices, which are of the vertically operated steel, shutter type, so common in Europe, are operated by electricity, as are also the locks and bridges. All of the forty sluice-gates along the canal are submerged, and no water for supply is passed over the breast walls.

One of the most interesting mechanical features of the canal is found in the application of electrical power to the operation of the gates. Owing to the height of the wells at the lower entrance and the solidity of the gates, each large leaf weighs fully 90 tons in the air. Preliminary experiments with a dynamometer on one of these when in place showed that a force of fully 3,000 pounds was required to move it through the water at the rate of 15 feet per minute. This movement was effected by attaching a horizontal operating bar or strut to the gate about half way between the heel and miter. On the side of this strut a rack of sufficient length was fixed into which a pinion was geared and driven by electrical power. A system somewhat similar has been in use on the North Sea canal for several years. It might be noted in conclusion that three small rivers, tributaries of the St. Lawrence, pass under the Soulanges Canal through iron pipes.

The second most important canal of the St. Lawrence system is the Cornwall, which is 11½ miles in length, overcomes a lift of 48 feet and ends at the town from which it derives its name. The Welland Canal, although as explained not in the St. Lawrence system, constitutes a most important link in the chain of communication which the new waterways have opened up. The Welland, extending from Lake Erie to Lake Ontario, is almost 27 miles in length and has a total rise of about 327 feet. It was opened in 1883 for vessels drawing 12 feet of water, and four years later for vessels with a draught of 14 feet.

The locks of the Welland and St. Lawrence Canals are, as has been stated, 270 feet long from the miters of the gates, and 45 feet in width, but this does not convey a strictly correct idea of the largest size of vessel which may lock through, this being dependent upon the model of the bow and stern of the vessel. A vessel that is sharp forward at the deck line and narrow at the stern can lock several feet longer than one that is nearly full beam of the locks. The reason why a steamer of narrow beam may lock through longer is found, of course, in the fact that she may



AN OLD CUTLER'S SHOP AT THE EXPOSITION.

be swung to one side of the lock and one gate opened, and then to the other side of the lock while the other gate is being opened.

It will thus be appreciated how vessels ranging all the way from 240 to 270 feet represent the maximum capacity of the locks for craft of different types. Generally speaking, however, it may be stated that the vessels especially adapted for traffic on the St. Lawrence route are each capable of carrying, on an average, 68,000 bushels of wheat or 3,000 tons of iron ore.

There have been a large number of these vessels constructed within the past two years, and the shipyards of the Great Lakes being unable to supply the ships as rapidly as desired, several contracts were placed abroad. The majority of the vessels thus far constructed are designed especially for the grain trade, an American syndicate having planned to build great elevators at Montreal and ship at least 25,000,000 bushels of grain via that route each year. The new canal system is also serving as an impetus to the shipbuilding industry on the Great Lakes, several vessels for Atlantic service having been constructed on the inland seas within the past year.

Destruction of Rats by Bacilli.

Now that the rat is considered to be an important agent in the spread of plague, means are being adopted to lessen its numbers. For this purpose, J. Danysz proposes to employ cultures of an organism, recently isolated by himself, which is pathogenic for the rat. The organism was isolated during an epidemic occurring among field mice. It is a short bacillus, somewhat like the Bacillus coli, and at first is only slightly pathogenic to rats. By cultivation in broth and upon agar and successive passages through rats, its virulence toward these animals is much augmented, and they contract a fatal disease by ingestion of food contaminated with the organism. In one experiment 200 rats were fed on bread steeped in broth cultures of the organism, and in less than three weeks 80 of the animals succumbed. Tried practically in a store and in some stables, a great diminution in the number of rats was noticed after a dissemination of cultures of the organism.—Ann. de l'Inst. Pasteur.

THE OLD CUTLER'S SHOP AT THE EXPOSITION.

An example of the life led of old by a family of working people outside of the often unwholesome agglomeration of workshops was offered at the Exposition in the cutlery shop of "Old Poitou." It was a large room, at the back of which was a bed with coverings of coarse fabric, and around which stood rustic chairs here and there. Strips of bacon for drying were suspended from nails in the ceiling. In the fireplace hung two pots, one for the kitchen and the other for the tempering of knives and scissors. A large wooden wheel placed against one of the walls attracted special attention. It was this that, through its revolution, set in motion the cutler's grindstone. In this room the cutler worked from morning till night, while his wife occupied herself with the cares of the household.

But what revolved the big wheel? Scarcely had the cutler seated himself in front of his grindstone when a large dog jumped into the wheel, and, beginning to walk therein, set it in motion.—Lectures pour Tous.

Bids for Raising the "Maine."

Five bids were opened recently in Havana for the raising of the "Maine." The amounts asked for varied from $735,000 to $80,000. The bids were rejected and new ones asked for, to be opened on February 1, 1901. There is a stipulation that dynamite shall not be used in blowing up the vessel. The successful bidder may retain the ship. Twelve new bids were tendered.

The Current Supplement.

The first page engraving in the current Supplement, No. 1310, is devoted to a fine portrait of Lord Armstrong, who has done so much for ordnance and naval engineering. "A New Page-Printing Telegraph" describes the invention of Mr. Donald Murray. "Nineteenth Century Medicine" is an important and elaborate article. "The Silkworm" is a valuable article, accompanied by many interesting engravings. "Corn Growing" describes the result of twelve years' work at experiment stations. "The Hall of Illusions at the Exposition of 1900" gives interesting details of lighting. "The New Rifle of the Germany Army" is fully described and illustrated.

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PATENTED INVENTIONS.

Agricultural Implements.

SICKLE-GUIDE.—JAMES T. LIGHTNER, Red Bluff, Cal. The body portion of the sickle-guide has a laterally projected tongue formed with a cavity on its under face to receive an anti-friction roller, held in place by a keeper. A bolt is mounted in the body of the guide and is formed on its lower end with a cone, situated in a cavity in the under side of the body. Located on the bolt and within the cavity of the body is an anti-friction cup-wheel which engages bearing-balls. The construction provides an admirable anti-friction guide for the finger-bars of harvesting-machines. The sickle is held true in every direction without materially increasing the friction.

TRIP FOR HAY-FORKS.—JOHN PATTEN, SR., Manti, Utah. In some hay-forks the position of the trip is such that only a certain amount of pressure can be exerted when the fork is closed. Therefore it frequently happens that the center of the load drops out before the trip is sprung. Mr. Patten has devised a fork by which this difficulty is overcome.

POWER DEVICE.—RODDY C. COBLE, Marion, Kan. This power device is particularly adapted for use in connection with hay-stacking machines, the purpose of the invention being to provide a portable device having means for ready attachment to the body of a hoisting-machine and connection with the hoist of such machines. The feature of the present invention relates to the manner in which a fork, for example, is raised and lowered. Such a construction of elevating mechanism is provided that a fork may be made to drop without backing the animal employed to operate the power mechanism.

Engineering Improvements.

ROTARY FURNACE.—CHARLES GROLL, Roubaix, Département du Nord, France. A certain number of pieces are so combined that their expansion does not modify the contour of that portion of the periphery of the grate which forms the joint at the contact, or nearly at the contact, of a ring fixed to the walls of the hearth. The expansion of all the parts, whether fixed or moving, forming the joint between the grate and ring is much reduced and equalized by the action of a current of air which is circulated around the periphery of the grate. The pivot of the grate is mounted on a cross-piece fixed at one end to the ring, and capable of longitudinal movement at the other end. The play left between the fixed and movable parts of the furnace is exceedingly small, so that the fragments of coal cannot enter between the parts.

VACUUM-PUMP.—CHARLES E. LEGGETT, Joplin, Mo. This pump is actuated by the pressure of steam against water to expel the water from the pump cylinder or reservoir, the steam being then condensed to form a vacuum, or partial vacuum, into which water flows to fill the cylinder. The apparatus is constructed with special reference to its use in mines, where it is necessary to use a pump capable of handling much water in a short time and of being economically slowed down when the water in the mine has been placed under control.

SUPERHEATING APPARATUS FOR FEED WATER OF MARINE BOILERS.—MASSIMO LEVI and GIACOMO RADONICICH, Venice, Italy. This invention provides in the smokebox of steam-boilers in general, but in marine-boilers in particular, economizing arrangements of tubes through which the feed-water is compelled to pass before being fed into the boiler, for the purpose of causing it to absorb heat from the gases of combustion in the smokebox. Thus the expense for fuel may be considerably diminished; for, hitherto, much energy has been dissipated with the hot gases into the atmosphere.

Gas Apparatus.

ACETYLENE GAS GENERATOR.—THEODORE G. AMES, 1200 South Walter street, Albuquerque, New Mexico. The invention provides a simple and practical machine for generating acetylene gas. The machine may be cheaply and strongly constructed with couplings, holders, and fittings already on the market. These parts, when properly adjusted, will act automatically until the charge of calcium carbid is exhausted.

APPARATUS FOR CARBONATING LIQUIDS.—GARRET D. RHINEHART, Newark, N. J. Mr. Rhinehart has devised a simple and effective means for producing a quick and thorough mingling of gas and liquid in a soda fountain. The apparatus is so constructed that the gas enters the fountain at its bottom portion. A water supply and water overflow are provided at the upper portion of the fountain. According to the invention, two fountains can be so coupled together that both may be simultaneously or independently supplied with gas and water, so that the overflow of one or both fountains can be brought into operation as desired.

Mechanical Devices.

LOCK.—CHARLES M. BURNS and FREDERICK T. MERCER, Philadelphia, Pa. The lock can be operated either by a knob or by a key, or by both. When desired, an extra key-operated latch can be employed to prevent the knobs from turning; the door, however, may be readily opened by means of the key. The bolt from the keeper section of the lock is automatically made to enter the body of the lock when the door is closed. A spring latch or bolt is not required, whereby the face-plate of the body of the lock and the surface of the door receiving that plate will not be marred by openings or projections.

ADDING-MACHINE.—JONATHAN T. DAVIS, Greenfield, Mo. This is an ingenious key-operated machine for mechanically adding amounts of any size. The construction is such that the machine can be sold for a comparatively low price and operated with ease. Columns of figures can be quickly added without mental exertion and with no error, if directions are followed.

TENSION DEVICE.—WILLIAM GERHARDT, Hazleton, Pa. The purpose of this invention is to provide a tension device adapted particularly for controlling the wires leading current to electrically-operated cloth-cutting machines, which tension device permits entire freedom of movement of the machine without danger of entangling the wires. The slack of the wires is taken up by a weight which is so combined with sheaves that the wires can be drawn out as the machine is moved away from the tension device.

CARTRIDGE LOADER AND RELOADER.—WHEELER W. MOORE, Rushville, Ill. The device removes the spent caps from cartridges and applies fresh caps, trims the edges of the cartridges and crimps them after they have been loaded. The cartridge tool has a body with a transverse passage. A revoluble crimping-cap is in alinement with the passage. With this crimping-cap the cartridge is pressed into engagement. A movable cartridge-holder employed in connection with the crimping-cap is projected through the passage mentioned. A knife is arranged adjacent to the holder so as to engage the cartridge and trim it.

TRANSMITTING-GEAR FOR WINDMILLS.—JESSE H. ALLISON, San Antonio, Texas. The windwheel-shaft is mounted in brackets and is provided with a pinion. An elongated internal rack is held in mesh with the pinion. Downwardly-projecting rods secured to a ring mounted in a circular bearing on the tower carry a bearing at their lower ends, through which the shank of the rack loosely passes. By reason of this construction a long stroke is imparted to the pump-rod or other device.

Electrical Apparatus.

CLOTH-CUTTING MACHINE.—WILLIAM GERHARDT, Hazleton, Pa. The machine can be freely moved over the cutting-table to cut the cloth without necessitating the operator's using one hand to press the cloth down and feed it in position, since this frequently causes the operator to be seriously cut by the machine. On a framing secured to the base of the machine a motor is carried. Below the motor two stub-shafts are mounted having transverse openings in their ends. Each stub-shaft carries a circular knife provided with a bevel-gear. A vertically-disposed rotary shaft, geared with the motor, extends through the openings in the ends of the stub-shafts. These openings form bearings for the vertical shaft. The bevel-gears on the knives mesh with bevel-gears on the vertical shaft.

Miscellaneous Inventions.

UMBRELLA-NOTCH.—WILLIAM DAVISON, 1 Queens Down Road, Clapton, London, N. E., England. The invention consists of a plain, perforated flange (stamped out in one with a cylindrical collar or tubular portion), in combination with U-shaped wire staples, which are fixed in the holes in the flange, the staples before being so fixed being threaded through the usual pivotal holes in the ends of the ribs or stretchers. Each rib or stretcher will, therefore, swing upon the bow portion of the corresponding staple. The staples are clenched in the flange by bending their points over at right angles or twisting them at the side of the flange opposite to that from which they project.

STOVE.—ERNEST C. COLE, 3218 Western Avenue, Chicago, Ill. In stoves which burn soft coal a large mass of fuel is put into the combustion-chamber, with the result that a large volume of gas is set free which cannot be controlled without overheating the stove. To avoid this difficulty Mr. Cole forms the combustion-chamber with a series of openings at the bottom, communicating with a surrounding chamber, whereby the products of combustion find exit only through these openings. Through the burning fuel, which is amply supplied with oxygen by means of a blast draft above the openings, and by means also of a grate below the openings, the flues will be prevented from filling with soot.

DENTAL BRIDGEWORK.—AUGUST P. JOHNSON, Ada, Minn. All-porcelain post-crowns have metallic posts for attachment to the natural-tooth roots. These posts are provided with lateral projections or arms which pass through the body of the crown and project on the side, where the ends are enlarged to form a base for the attachment of the improved dummy-crowns constituting the bridge proper. A strong bridge is thus produced from all-porcelain post crowns and all-porcelain dummy crowns.

SEAL FOR MILK-BOTTLES.—HENRY O. ROBINSON, 103 East Brooks Street, East Boston, Mass. As seals for milk-bottles, sheet-metal disks have been employed, provided with a central fold. Pasteboard disks have also been used, provided with a hinge. Both of these seals are objectionable for various reasons. In this invention a regularly oval pasteboard-plate is provided with a single, central crease in the under side and two crimps in the upper side, which are parallel to and equi-distant from the central one. By reason of this novel construction the plate is enabled to fold in the manner required.

POLE OR SHAFT COUPLING.—ROBERT O. NEVILLE, Elkhart, Ind. Mr. Neville has devised a simple anti-rattling coupling which holds the pole-iron or thill-irons connected with the draw-shackles, while the pole or thills are in use, or when they have been placed in an upper or lower position for the storage of the vehicle, or when the animals are unharnessed. The device is so constructed that the thill iron or pole iron may be quickly disconnected from the draw-shackles. The coupling is manufactured by the Elkhart Carriage Specialty Company and Indiana Buggy Company, of Elkhart, Ind.

ACETYLENE-GAS GENERATOR.—FRANKLIN E. LAYTON, Corning, N. Y. The apparatus comprises a gas-holder and a generator which employs a feeding apparatus by which the carbid is discharged into a surplus of water in the generator in small quantities. As the gas-holder rises to its maximum height, the valve through which the carbid must pass is automatically closed to stop the generation of gas; as the gas-holder falls, the valve is opened. The refuse can be readily removed from the generator without cutting off the supply of gas; and the carbid-holders can be refilled without interfering with the operation of the machine.

GARMENT-FASTENER.—MOSES W. WINSTON, Manhattan, New York city. The fastener is of the ball and socket type and consists of a button member projecting from one section and extended in the direction of the other section and inclosing the point of junction of these sections.

SAFETY-ADJUSTER FOR PRINTING FILMS.—BENJAMIN DAY, West Hoboken, N. J. This invention relates to adjustable holders for frames for printing films used in lithography or similar arts. By means of the construction provided, the operator is enabled accurately to adjust and hold the frame-film; to adjust, remove and readjust the film after inking or re-inking, with the certainty of obtaining accurate shading; and to shift the frame minutely and accurately in two directions, thereby throwing subsequent prints slightly out of register with the first print, so as positively to cause the subsequent prints to overlap, continue, or thicken the original print to produce darker tones of the original tint. Thus, the shading can be accurately varied.

CALCULATOR.—FREDERICK D. FERGUSSON, Paeroa, Auckland, New Zealand. The object of the invention is to provide a new and improved calculator which is easily manipulated and which is more especially designed for calculating timber, earth quantities, interest, etc. The invention consists principally of carriers or blocks movable in parallel guideways, a connection between the two blocks, and a scale between the guideways, on which the connection is read.

CAN-HOLDING ATTACHMENT FOR LADDERS.—HARVEY KEPLER, Dawson, N. D. The attachment is intended to hold paint-cans, and consists of a plate on one end of which is a guide-block for engaging the channel formed in one of the side rails of a ladder. A spring-pressed jaw on the lower portion of the plate engages any of the teeth in the channel. An arm, extended from the plate, has a hook portion to engage in the channel, formed longitudinally in the inner side of the side-rail of the ladder. With the plate, a can-holding platform is removably connected. The attachment can be adjusted to hold the can level at any angle, either while the side of a building or a roof is being painted.

WINDOW OR DOOR.—CHARLES E. REYNOLDS, Bronx, New York city. In this window or door, a joint and locking strip is adapted to extend simultaneously into adjacent grooves and is arranged to pass wholly into one of the grooves. The strip has a number of inclines. An operating-plate is mounted to slide lengthwise of the joint strip and has a number of inclines engaging the corresponding inclines on the strip. The window sash or door can be readily manipulated in the usual manner or disconnected from the adjacent part for cleaning. A perfect joint is produced between the parts to prevent draft and exclude dust.

SHINGLING-BRACKET.—WARREN L. DUDLEY, Watertown, Minn. This shingling-bracket comprises a base adapted to extend transversely under adjacent shingles. At or near the middle of the base an upright rises. A key moves transversely in a slot in the upright to bear on the top of adjacent shingles and clamp the bracket in position. The upright forms a rest for a part of the staging. This shingling-bracket can be readily placed on a shingle roof to support a stud or other part of the bracing.

HEATER.—HERMAN SCHWICKART, Brooklyn, New York city. The heater has a perforate shell in which spaced deflectors are contained, one above the other, and formed to produce a central draft space and inwardly and upwardly inclined air passages. These passages begin at the perforate shell and lead to the central draft space at a point above the base end of the next deflector above. A heating and free circulation of air is established, so that it is possible to heat a large quantity of air with a small amount of fuel and at the same time cause a proper circulation of the air in the room.

SAW-HANDLE.—CHARLES W. STITES, Manhattan, New York city. The saw-handle is so secured upon the saw-blade that it can be quickly detached without the use of a tool, and that it can be attached by the latching movement of a portion of the handle. The handle can be applied to any number of saw-blades, which may be carried so that they take up but little space.

CIPHER-CODE SYSTEM.—CHARLES P. HALL, Manhattan, New York city. This new cipher-code system enables one to send long messages with the use of very few words or numerals. The system employs a book having an index-page with a column containing subject words or sentences; a column containing cipher numerals for the subject words of sentences; and a key for the message, arranged for use in connection with the numerical value of the message, to change the numerical value. Besides permitting the receiver readily to decipher the message sent, secrecy can be preserved.

ARTIFICIAL FLOWER MADE OF FUR.—CARL HARTMANN, Manhattan, New York city. Mr. Hartmann has devised an economic and practical means whereby artificial flowers can be made from furs, the flowers being so formed that the nap of the fur will naturally run or lie in the direction of the outer edges of the petals or flowers. The parts of the flowers are so assembled that their centers are independent of the body of the flowers, whereby these centers may be fixed in position simply and quickly.

WELL-PACKER.—FRED J. MOSER, Kane, Pa. Heretofore, owing to the great pressure in oil-wells and the unevenness of the walls, the packing of the wells has been accomplished with difficulty. According to this invention, an annular packing-tube of rubber is employed, which tube is formed with an annular chamber. When this chamber is filled with a fluid, pressure on the end of the tube will be evenly distributed around all the sides of the tube. By these means the tube is caused to expand against the walls of the well, and to adapt itself to inequalities and effectively sealing the bore.

Designs.

BLANK FOR PAPER BOXES.—JOSEPH T. CRAW, Jersey City, N. J. Mr. Craw has devised a one-piece blank from which boxes can be easily made to meet the various requirements of manufacturers.

BELT.—LOUIS SANDERS, Brooklyn, New York city. To the many belts which Mr. Sanders has already designed may be added the one which forms the subject of the present patent. In this new belt two members are employed, which interlace and lose themselves in the longitudinal edges of the belt.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE METALLURGY OF GOLD. A Practical Treatise of the Metallurgical Treatment of Gold Bearing Ores, Including Assaying, Melting and Refining of Gold. By M. Eisler. London: Crosby, Lockwood & Son. New York: D. Van Nostrand Company. 1900. 8vo. Pp. 638. Price $4.50.

The fifth edition of a standard treatise upon the metallurgy of gold is now before us. It is illustrated with 300 illustrations and numerous folding plates. The gratifying demand for successive editions of this work, together with the striking and continued advance made during the last half dozen years in the way of appliances for gold mining has led to the great expansion of the work before us. The use of the cyanide process alone would make a new edition imperative. A careful examination of the book shows that every phase of the subject is treated with great care, the relative values of the various processes being carefully considered. It is probably the best book on the subject for the American and English reader.

THE ATTAINMENT OF WOMANLY BEAUTY IN FORM AND FEATURE. Edited by Albert Turner. New York: The Health Culture Company. 1900. 12mo. Pp. 256.

The book consists of a number of chapters written by the various authorities, and the whole forms a compilation of considerable interest to women.

GLUE AND GLUE TESTING. By Samuel Rideal. London: Scott, Greenwood & Company. New York: D. Van Nostrand Company. 1900. 8vo. Pp. 140. Price $4.

The author has rendered a substantial service to technical literature in the preparation of the present volume. He has gained very valuable experience by the examination of commercial samples. There are too few books

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upon such subjects as the present. It is a book which all who are in any way connected with glue will find absolutely indispensable.

PRINCIPLES OF CHESS IN THEORY AND PRACTICE. By James Mason. London: Horace Cox. 1900. 16mo. Pp. 327. Price $1.

The author is a well-known chess expert and he has produced an admirable book. What he terms the "elements of chess" is particularly valuable. It gives not only the rules of the game, but common sense directions for playing it. The diagrams are unusually clear.

HAND-BOOK OF THE ELECTRO-MAGNETIC TELEGRAPH. By A. E. Loring. New York: D. Van Nostrand Company. 1900. 16mo. Pp. 116. Price 50 cents.

The first edition of this work was published in 1878, and the original text has now been thoroughly revised, so as to include the present state of telegraph practice. A new chapter describing in outline the new duplex and quadruplex methods of telegraphy has been added.

BERICHT VON SCHIMMEL & COMPANY. (Inhaber Gebr. Fritzsche.) Fabrik äther. Oele, Essenzen, und Chemischer Präparate. 1900. Leipzig.

DIE ASSANIERUNG VON PARIS. Bearbeitet von Dr. med. Th. Weyl. With 56 illustrations and 3 maps. Leipsic: Wilhelm Engelmann. 1900. Octavo. Pp. 62. Price, paper, $2.

This book is the first of a series of monographs on the sanitation of the world's large cities. The pamphlet before us is a clearly-written, fairly well-illustrated account of the system by which the city of Paris disposes of its waste products, receives its water, and is drained. The account is thoroughly scientific, and so far as we have been able to determine, fully trustworthy.

ROPER'S CATECHISM FOR STEAM ENGINEERING AND ELECTRICIANS. Including the Construction and Management of Steam Engines, Steam Boilers, and Electrical Plants. By Edwin R. Keller, M.E., and Clayton W. Pike, B.S. Philadelphia: David McKay. 1900. 18mo. Pp. 365. Price $2.

The great value of a catechism lies in the fact that a judicious questioning emphasizes the more important points of a subject, and also stimulates the student to think more definitely and clearly upon it than would be the case if merely reading about it. In these respects the written catechism is the best substitute for oral teaching, and the authors have performed their task in the preparation of the present volume in an admirable manner. It was written by Stephen Roper in 1873, and has been so useful and popular that twenty-one editions have been called for. The present is rewritten and greatly enlarged. It is profusely illustrated.

PITMAN'S TWENTIETH CENTURY BUSINESS DICTATION BOOK OF BUSINESS LETTERS, LEGAL DOCUMENTS AND MISCELLANEOUS. New York: Isaac Pitman & Sons. 1900. 16mo. Pp. 240. Price 75 cents in boards, cloth $1.

A most valuable book for all who are interested in stenography. It is a complete manual of dictation for the use of schools, colleges, teachers, law stenographers and students of shorthand and typewriting. The letters are admirably selected and cover a vast range of subjects. We notice on page 87 one of our own letters relative to patents on inventions.

ON SANITARY AND OTHER MATTERS. By George S. Keith, M.D. London: Adam & Charles Black. New York: The Macmillan Company. 1900. 12mo. Pp. 127. Price $1.

The author's chapters deal with the waste of water in houses and the modern systems of treating and nursing infectious diseases, how to profit by life at sea, on rice meal, the story of an eye, and the rapid and progressive deterioration of the young, on athletics, etc. The papers all point out the prevailing errors of sanitary or economic matters which seriously affect the well-being of the community, and which, but for the strangely resistant force of conventionalism, could easily be set aside and with much advantage to all.

ROYAL NAVY LIST DIARY AND NAVAL HAND-BOOK FOR 1901. London: Whitherby & Company. 1900. Pp. 535. Price $1.25.

This is the fourth volume of a publication which has been well received by the naval officers for whom it is specially prepared. Over 400 pages are devoted to the diary, a page for each day of the year. At the end of every month is a printed page on which the officer may enter the dates on which the various drills, incidental to the vessel in commission, took place in that particular month. At the commencement is a considerable amount of historical and statistical information respecting the Royal navy, including an important article on the naval progress of the year by L. Carr Laughton. The handbook contains several pages devoted to astronomical phenomena of the year, and there are also tables of tides and tidal constants, together with a variety of information to meet the special needs of the naval officer.

Business and Personal.

Marine Iron Works. Chicago. Catalogue free.

For logging engines. J. S. Mundy, Newark, N. J.

"U. S." Metal Polish. Indianapolis. Samples free.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Rigs that Run. Hydrocarbon system. Write St, Louis Motor Carriage Co., St. Louis, Mo.

Machinery designed and constructed. Gear cutting. The Garvin Machine Co., Spring and Varick Sts., N. Y.

New Book.—Design and Construction of Oil Engines. By Goldingham. By mail, $2. Spon & Chamberlain, 12 Cortlandt St., New York.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8039) J. S. asks: How to make a small heater by utilizing a 110-volt electric current. A. For a small electric heater use iron wire of a size which will carry the current, and take enough to have the needed resistance. Coil this, and mount the coils on iron frames covered with several thicknesses of asbestos cloth to prevent short circuits. You can get an idea how to make the heater by examining the cuts of heaters in the catalogues of makers of such articles. If you wish 5 amperes or thereabout to flow when the wire is hot, take 300 feet of No. 18 American wire gage iron wire. You will see that the heater is but a rheostat applied for use as a heater. It may be provided with a switch, so as to give various degrees of heating. The rheostat of an electric lantern will answer very well as a heater.

(8040) W. E. G. asks: How can I establish upon my premises a pond for the pleasure of my water fowl—say, 30 by 40 feet, fed by the water supplied by the corporation? My land is a rich loam, with loose subsoil. A. For preventing seepage into the soil from an artificial pond, make a puddle of clay and sand about equal parts or a little more clay if the sand is coarse or loamy. Ram it well all over the bottom, and rise within the embankment to the top or above the water line. If carefully done with the embankment previously wet-rammed, the clay puddle may only line the bottom and side and be covered with sufficient sand to protect it. The thickness of the puddle depends upon the depth or pressure. If from 5 to 7 feet deep, the bottom puddle should be 1 foot thick and the sides may taper to 6 inches at the top above the water line. The overflow may be a pipe leading through the bottom or side as convenient, with a strainer, or may be a stone dam overflow protected by a net of galvanized wire, if it is to be also used as a fish pond.

(8041) M. T. writes: Please give me the resistance of 1,000 feet of German silver and platinum wire of the following numbers by B. & S. gage: 30, 31, 32, 33, 34, 35, 36; also price and place where they can be purchased. A. The resistance of German silver is 12.9 times as much as that of the copper wire of the same size and length, and that of platinum is 5.5 times that of a copper wire of the same size and length. Hence, if you multiply the number of ohms per 1,000 feet of copper wire from the tables by these numbers, you will have the resistance of 1,000 feet of German silver and of platinum wire respectively. Lest you may not have the figures for copper wire, we add them for B. & S. gage:

No.	R. per 1,000 feet.
30	103.30
31	124.27
32	164.26
33	207.08
34	261.23
35	329.35
36	415.24

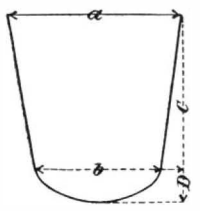
Any dealer in electric material can obtain these wires. See our advertising columns from time to time.

(8042) C. W. C. asks: 1. Can you tell me if phosphorus is dangerous to handle? A. Yes. 2. Is it an explosive, or what is there about it that is dangerous? A. No; it is not an explosive. An explosive is a substance which is suddenly transformed into a gas, occupying many times the space which the substance occupied before the explosion. The danger from phosphorus arises from the ease with which it takes fire. It is the substance which is used upon the tips of ordinary matches to ignite the wood. 3. How does it come? A. It is sent to market in rolls about ½ inch in diameter and 3 inches or thereabout long. 4. How long would a piece 1 inch long and ½ inch square burn if about ⅛ of an inch was exposed at a time? A. It could not be controlled in burning in that way. It would burn very violently when set on fire, as a match does. 5. Does it burn with a flame when not submerged in water? A. Yes. 6. Can you tell me some other chemical that would burn with a flame by pouring acid or water on it? A. Potassium or sodium will take fire when dropped into water, and burn in the water. 7. What is its cost? A. Potassium is about $1.50 an ounce, and sodium about 30 cents an ounce. 8. In what form does it come? A. In sticks in bottles covered with kerosene to prevent them from taking fire. No one should play with any of these substances. They are very dangerous, and frequent accidents result from people without experience attempting to handle them.

(8043) J. B. H. writes: In our business, as in many others using large quantities of liquid mixtures, there is often occasion to find the contents of a kettle or other round vessel, or to find the number of gallons already in any such kettle when the contents are of a known depth. I send you the formula which I have found for use in such cases. With it the labor of computing is, I believe, reduced to a minimum. Should you consider it worthy of publication in your magazine, I have no doubt it will prove helpful to some of your readers. To find the capacity in gallons (of 231 cubic inches) of any vessel having straight sides (either parallel, convergent, or divergent), having a circular horizontal cross-section and having a flat, spherical, or spheroidal bottom,

$$\frac{3C(a+b)^2+8Db^2}{3529} = \text{capacity in gallons.}$$

Measurements are all in inches. In case the vessel has a flat bottom, the second term in the numerator of the fraction disappears. A. The formula given above is an approximation, perhaps close enough for factory use, but in any special case the result obtained from its use will vary somewhat from a correct gaging of the kettle. It would seem to be better to gage a new kettle before it is put into use by measuring the depth for each



unit of quantity of water used in filling it. A table of these results kept near the kettle will enable the workman to work with accuracy, and without the trouble of making any calculation in order to find the quantity of liquid in the kettle. He will only need to measure the depth of the liquid in the kettle, refer to the table, and opposite the depth read the quantity in gallons or any other desired unit. Much time would in the long run be saved.

(8044) C. E. T. asks: 1. How would you wind, and with what size wire, the armature and field magnet of the hand power dynamo in "Experimental Science" in order to secure the best results of electric lighting on a small scale; that is, to light the greatest number of small lamps with this dynamo? A. We should not change the winding from the plan given in "Experimental Science." The machine will give 10 to 12 volts and about 3 amperes at full speed. 2. How many lamps of one candle power, requiring 3½ volts and 1-5 ampere, will the hand power dynamo light at the winding in "Experimental Science"? A. Put three lamps in series to use up the voltage, and as many series as you wish till you use up the amperes. 3. If the primary coil of a telephone induction coil were attached to a magneto-electric machine, would the current received from the secondary coil be a direct current? A. No. If the magneto gives a direct current, there would be no secondary current at all. An induced current is only produced in the secondary when the primary current is varying, rising, or falling, starting or stopping. When the primary current flows without change of value, there is no inductive effect produced by it upon the secondary. An interrupter is introduced into the primary circuit to make and break the current; that is, to vary the strength of the primary current. Then there is a secondary current produced, which is alternating in character, when the secondary terminals are brought together; but is interrupted and in one direction when the terminals are drawn apart, so that a spark is thrown across the gap.

(8045) L. V. C. asks: Will you tell me the time necessary to magnetize steel blocks? A. Very little time is needed to magnetize steel to saturation, by a suitable current, such as is given by a dynamo. A few seconds will suffice. There is little gain in strength by prolonging the process.

(8046) O. S. asks: 1. About how many pounds of wire would it take to wind the armature and field coils of the simple electric motor of SCIENTIFIC AMERICAN, vol. lxxxiii, No. 23? A. About half a pound is required for the armature, and about the same quantity for the field. The quantities are given in the description in feet. 2. Is it possible to use this motor as a hand generator, and, if so, how many volts should it give? A. Probably not. It is a little fan motor. 3. How many cells of battery (each giving 1.5 volts) would be required to run the above motor? A. Six or more.

(8047) W. F. G. asks: 1. Is it necessary for best results to include Leyden jars in the circuit of a focus tube? A. Yes; in using a static machine for exciting the tube. 2. Are thin copper sectors of a Wimshurst required to be in perfect contact with the glass at all points? A. No; though it is desirable to fix it as completely as possible to the glass.

(8048) R. N. D. asks: 1. Is the ordinary bichromate battery, consisting of a zinc plate suspended between two carbon plates in a solution of bichromate of potash and sulphuric acid, a closed circuit battery? A. No. The battery polarizes quite rapidly on closed circuit. 2. Should the zinc plate be removed from the solution when not in use? A. Yes, always. And after the battery has worked a few minutes, the zinc should be raised and lowered to displace the hydrogen. 3. Is it necessary to amalgamate the zinc? A. Yes.

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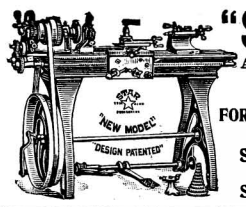

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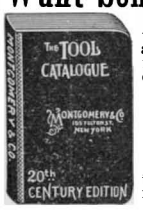

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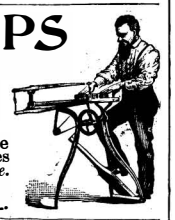

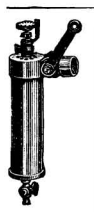
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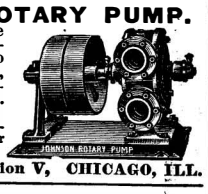

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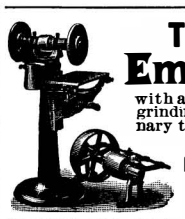
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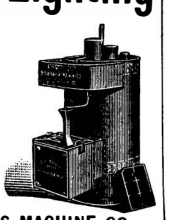
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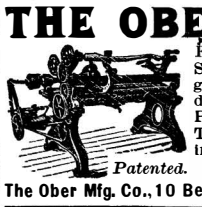
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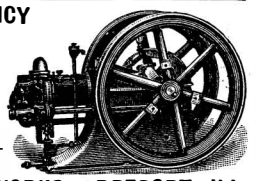
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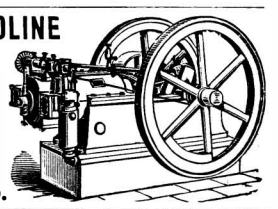
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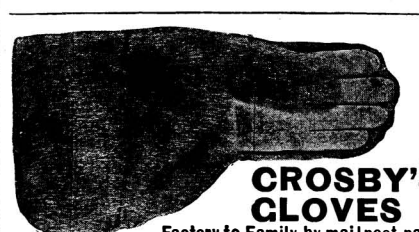
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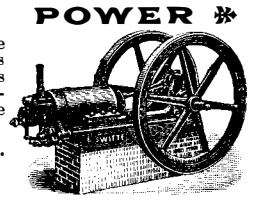

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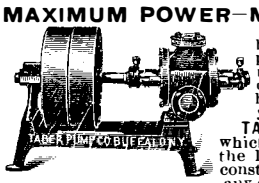

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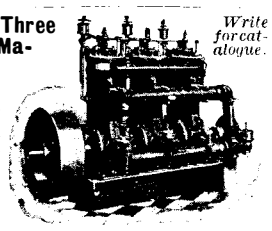

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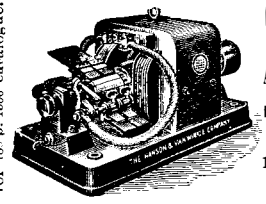

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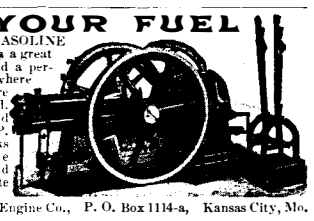

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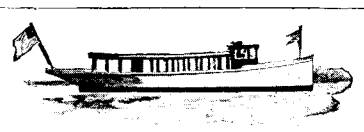

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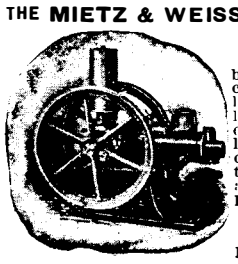

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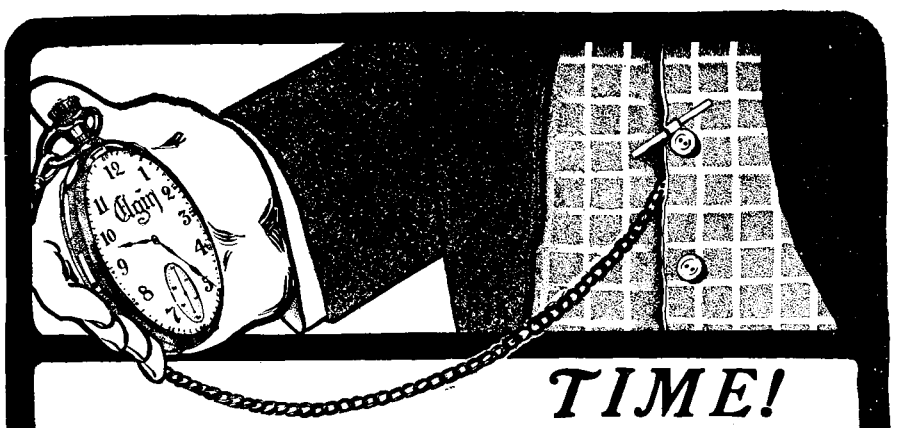

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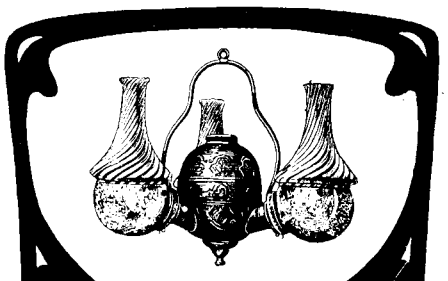

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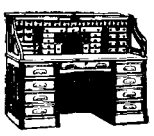

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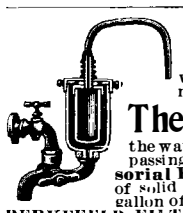

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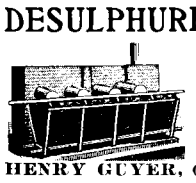

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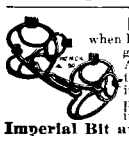

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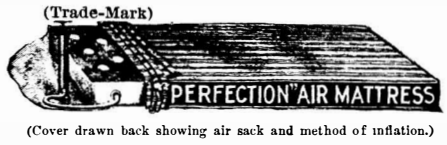

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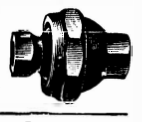

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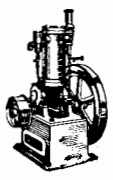

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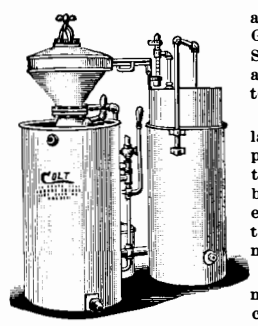

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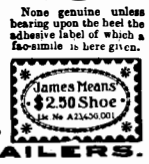

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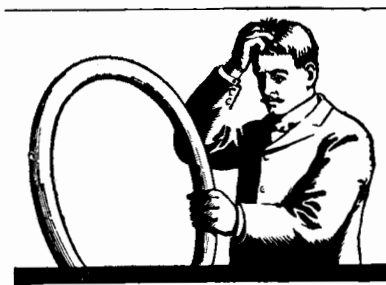

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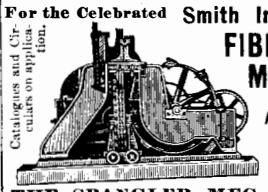

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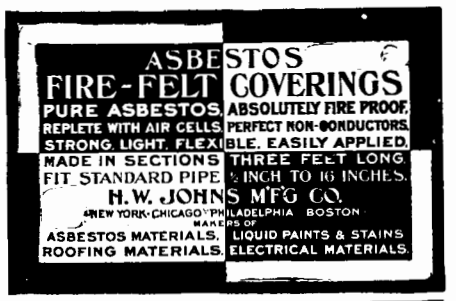
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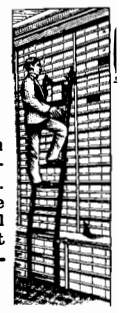

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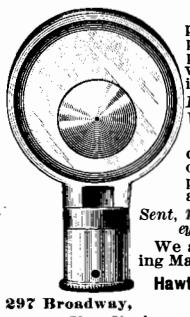

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